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Contents.

	PAGE
Notes and Comments	201
The Iron and Steel Institute	202
The "Characteristic Curves" of the Heat Treatment of Steels	203
Does the Critical Point Depend on the Strength of the Magnetising Field?	204
The Shipping, Engineering and Machinery Exhibition	205
Moulding a Surface Condenser	207
Cast Iron for Automobile Cylinders.—Part II.	212
"Pyrotip" Heater	214
Heat Treatment of Rock-Drill Steel	215
Trade Talk	216
Applications for Patents	217
Gazette	217
Company News	217
Personal	217
Iron and Steel Markets	218

THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTION OF BRITISH FOUNDRYMEN AND THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION.

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NOTES AND COMMENTS.

The Work of the British Cast Iron Research Association.

The Acting-Director of Research of the British Cast Iron Research Association, Mr. J. E. Fletcher, has already received from members some extremely interesting problems for resolution, and in several cases troubles which have been existing for several years have been eliminated, and large sums of money will undoubtedly be saved.

Amongst the research work which has already been undertaken by the Association upon problems as submitted by foundries who are members of the Association may be enumerated the following:—(1) Cast iron analysis and cupola mixtures suitable for castings subject to growth during service. (2) Abnormal structures in malleable iron castings; composition of metal and heat-treatment for its avoidance. (3) The elimination of shrinkage defects in grey-iron castings. (4) The curing of hard white cores in the interior of grey-iron castings. (5) The composition and treatment of ganister and other cupola and furnace-lining refractories. (6) The use of steel and iron turnings in cupola charges. (7) Investigation concerning composition of stucco and plaster patterns for machine mouldings. (8) Moulding and facing sand mixtures for light castings in green sand. (9) Moulding and facing sand mixtures for semi-steel castings. (10) The correct analyses of semi-steel for light, medium, and heavy castings; the rationale of mixing, charging, full ratio air supply, and casting temperatures for semi-steel work. (11) Cupola coke analysis and physical composition as influencing hardness of iron produced. (12) Preliminary stages in pig-iron grading problem. (13) Fundamentals in design of annealing furnaces for malleable castings. (14) Internal casting strains in castings and their correction. (15) Cast iron of suitable composition to resist erosive and corrosive action, as in centrifugal pumps, valves, pipes, etc.

In the investigation of these problems samples are being collected of defective and satisfactory character. Chemical, microscopic, physical, and heat-treatment tests are being carried out and a thorough investigation made, and reports issued to the members upon same. Already some very beneficial results have accrued to the members interested in the problems sent in.

The Bureau of Technical Information. — The Bureau is being used by members requiring foundry data, and is proving of very great value.

The Congress of Foundrymen at Liége.

The Association Technique de Fonderie, Belgium, at the request of the Association Technique de Fonderie de France, who are collaborating with them, have agreed to postpone the Congress for eight days. It will, therefore, be held from September 28 to October 1, in place of September 21 to 24 as previously announced. The banquet will take place on Saturday, October 1.

Visit to the Shipping, Engineering and Machinery Exhibition at Olympia.

The President and Council of the London Branch of the Institution of British Foundrymen invite all members of the Institution to meet them at 3 p.m. on Saturday, Sept. 24, at the main entrance to Olympia. It will facilitate arrangements if members proposing to be present will notify the Branch Secretary as early as possible.

SOUTH AFRICAN BUSINESS OPENINGS.—Mr. W. G. Wickham, his Majesty's senior Trade Commissioner in South Africa, is engaged on an official tour of this country for the purpose of discussing with firms the possibilities and conditions of United Kingdom trade with the Union of South Africa. The first part of his tour includes the following towns:—Leicester, on September 19 to 21; Nottingham, on September 22 and 23, Sheffield, on September 28 to 30; Leeds, on October 3 to 5; Bradford, on October 6 to 11. Firms in these centres desiring to interview Mr. Wickham should communicate immediately with the secretary of their local Chamber of Commerce. Arrangements to visit other industrial centres will be made and notified in due course.

THE INSTITUTION OF PRODUCTION ENGINEERS.—A general meeting of the Institution will be held on Saturday, September 17, at the Institution of Mechanical Engineers, Storey's Gate, London, S.W., at 7 p.m., when Mr. J. D. Scaife, Member of Council, and works manager of Messrs. Ransome & Marles Bearing Company, Limited, Newark-on-Trent, will read a Paper on "The Manufacture of Ball and Roller Bearings," illustrated by lantern slides.

The Iron and Steel Institute.

Autumn Meeting in Paris.

The Autumn Meeting of the Iron and Steel Institute was opened at the Hotel of the Comité des Forges, Rue de Madrid, in Paris, on September 5. In the absence of the President (Dr. Stead), unavoidably detained by illness, Sir Hugh Bell, Bart. (a Past President), presided. There was a very large attendance of members, and a number of French ironmasters were present.

An Address of Welcome.

At the outset Sir Hugh Bell introduced M. François de Wendel (President of the Comité des Forges), at whose invitation the Institute is meeting in Paris.

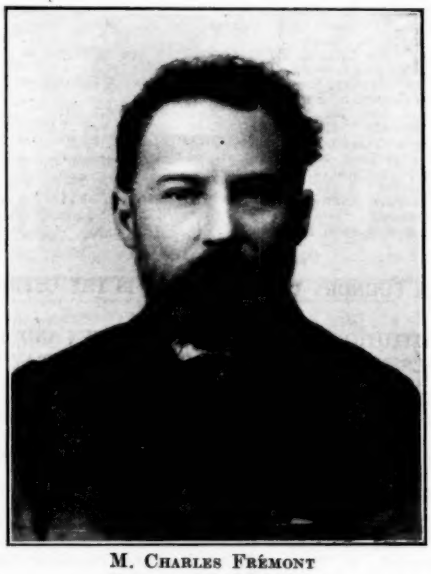
Speaking in English, M. DE WENDEL, who was welcomed with loud applause, expressed the great pleasure he felt in being called upon, as President of the Comité des Forges, to extend a hearty welcome to the members of the Iron and Steel Institute who had accepted the hospitality of the Comité for their Autumn Meeting. It was 21 years since a similar event had taken place. The last occasion was in 1900, at the time of the Paris Exhibition, and he remembered that by a happy coincidence it was a member of his family who then, as President of the Comité des Forges, had welcomed the visitors. He (the speaker) recalled that during the war it fell to his lot to meet many British ironmasters in London, and this led him to lay special stress upon the fact that no matter how cordial was the reception given in 1900 to the members of the Institute, it could not equal the reception offered that day to their English friends after the long and cruel war during which England and France had fought side by side in a common cause on the battlefields of France. When, as President of the Comité des Forges, he welcomed their English friends, the word "friend" had more than its usual significance attached to it.

Speaking especially of the intended visit to the Lorraine district, M. de Wendel said he did not wish them to study this district merely from a technical or economic point of view. He asked them to consider it from the higher standpoint of its broad political bearings He hoped they would take advantage of their short stay in France to examine the difficult problems that faced the country on whose borderland were situated the ironworks they would see. It could not be denied that recently divergencies had occurred between the respective Governments as to post-war problems and the application of the Peace Treaty. He did not want to stress the point, but thought he could ask friends like themselves to try during their short stay in France to place themselves in the French position and to understand the French mentality—the mentality of a people which did not enjoy the advantage of being separated from Germany by the splendid silver ribbon that encircled the British Isles. He could not do less than ask them to remember *that* when they saw the French works and factories which had been destroyed. Many were still not rebuilt three years after the war. So far as they had been rebuilt, they had been rebuilt with French money, and not with the money of those who demolished them. At the same time the works of those who created this havoc were running at full blast and again making a commercial conquest of the world. When they were visiting the Lorraine works that the Germans destroyed in 1918, he would ask them to look to the East and realise the fact that behind the blue hills—which although temporarily occupied by Allied troops, were still Prussian hills—were 60,000,000 Germans who to a man refused to comply with the Treaty, who to a man refused to pay indemnity, who to a man refused to accept responsibility for the war. The best and most patriotic of them were longing to secure their revenge, to recover what Germany had lost. These facts made him very anxious that special measures of protection should be taken against Germany. France could not afford to live in a false security. It was of very great interest to their two countries that they should realise the fact that 70 per cent. of French metallurgy had been located by Nature at less than 40 miles from the German frontier.

THE CHAIRMAN (Sir Hugh Bell, Bart.) said that before expressing the thanks of the Iron and Steel Institute for M. de Wendel's gracious words of welcome, he suggested that a telegram be sent to Dr. Stead expressing their regrets at his absence and their good wishes for his health.

The proposal was carried by acclamation and the Secretary instructed accordingly.

SIR HUGH BELL, continuing, thanked M. de Wendel for his kind words of welcome. They were always sure of a welcome from their French colleagues, and this assurance had indeed been fulfilled. They would all remember that the Institute was on the eve of paying another visit to France in the year 1914, and that all the arrangements had been made. Circumstances, which had now become a bitter memory, prevented that visit; they looked back over seven years of deep disaster, not only to France but also to the world at large, and it lay with them, with their French colleagues, and with the world at large, to repair as early as possible the disaster which befell the world with the declaration of war in 1914. France must of necessity take quite a different position in the metallurgical world in consequence of the changed conditions brought about by the war, and he ventured to affirm on behalf of his country that there would be nothing wanting on the British side to make that situation as profitable and advantageous as might be for France. M. de Wendel had spoken feelingly on subjects which were almost forbidden at such meetings as that, and he hoped the meeting would understand the deep feeling with which on their behalf he desired to express to the French the heartfelt hope that they might have a bright and untroubled future before them, and that the years to come might return to France all the prosperity she so richly deserved. In that prosperity, as in Great Britain and other countries, lay the hope of the world, so it was perhaps appropriate that at the first meeting of the Iron and Steel Institute since the war some expression should be given to the circumstances to which M. de Wendel had referred.



M. CHARLES FRÉMONT
(Bessemer Gold Medallist.)

The Bessemer Gold Medal.

In presenting the Bessemer Medal to M. Charles Frémont, SIR HUGH BELL said M. Frémont's title to the medal was indisputable. To science he added practice, and his researches in the metal which occupied their attention were of a profound and far-reaching character.

The Medal was then handed to M. Frémont, who attempted no formal reply, but shook Sir Hugh Bell's hand warmly before leaving the meeting.

The "Characteristic Curves" of the Heat Treatment of Steels.*

BY ALBERT M. PORTEVIN AND PIERRE CHEVENARD.

(*Abstract.*)

The authors remark that at the outset of a quantitative investigation of the influences of cooling, it should be pointed out that recent researches on the hardening of steel have led to the establishment with, in this instance, great accuracy, of the mutual relationship which exists between the two fundamental factors of all heat treatment—the temperature of heating and the rate of cooling. The final condition being a function of these two variables, it is easy to see the interest attaching to plotting a graphic representation of the result of a treatment by taking, for any given steel, these variables as co-ordinates. This method leads the authors to the establishment of what they have termed the "characteristic curves" of the heat treatment of the steel in question. Such curves not only combine, within a single diagram, the fundamental data of every possible heat treatment, but they also afford a means of defining accurately the annealed and hardened states of the particular steel, and therefore constitute the basis and indispensable preliminary of every treatment properly carried out with a particular object.

In order that such a graphic representation may be plotted accurately, it is necessary that the values from which it is built up shall be susceptible of numerical definition so as to be capable of measurement. The authors therefore first describe how they evaluate the rate of cooling and how they define the final state, that is to say, the result of the treatment.

Evaluation of the Rate of Cooling.—The authors take into consideration only the case of simple heat-treatments consisting essentially of heating to a temperature θc from which continuous cooling takes place according to a given law; a treatment which may be termed elementary, and which takes no note of more complex treatments in which the periods of heating may be varied, or in which the external conditions during the course of cooling are modified.

The latter, as a matter of fact, cannot be represented by any simple graph, and the problem becomes complex, although still remaining susceptible of being linked up with the fundamental data furnished by the characteristic curves. It must be conceded, in any case, that the law of cooling always remains the same, and that it can be regarded, in the first approximation, as definable by the initial temperature of cooling θc and by a single other parameter. The latter has been so chosen as to indicate the rate of cooling, for which purpose there may be adopted: (1) The initial rate of cooling, that is to say, the rate at the temperature θc, or (2) the average rate between any two determined temperatures, or its reciprocal, the duration of cooling, taken between these two limits.

If these limits comprise the regions of the transformation of the steel in the course of cooling, the heat liberated during these transformations affects the values of the average rate of cooling, or its reciprocal, the duration of cooling. For this reason it appears more accurate to select the initial rate at temperature θc as the measure of the rate of cooling, as by this means it is possible to define the conditions under which cooling takes place, independently of the perturbations introduced by the intervention of transformations. This is the plan the authors adopt in the case of coolings in air, or in gaseous media, for which Newton's law may be regarded as approximately correct. On the other hand, when cooling is effected by immersion in a liquid the initial rate is found to be ill-defined, experimentally, and it is preferable, in order accurately to determine the rate of cooling, to take the average rate between two temperatures far enough apart, or the time taken in traversing such a temperature interval.

Under these conditions a heat treatment would appear to be determined wholly by the values of two variables—the initial temperature θc and the rate of cooling V. These are the two co-ordinates of the diagram.

In the case of a heat treatment having as its object the modification of the properties of a steel, the result will be defined in terms of those properties. It is obviously not possible to take all of them into consideration, as each would require its own special diagram. Amongst those properties the mechanical properties are, from an industrial point of view, the most important, but their measurement, when hard quenched steels are in question, is precarious and often illusory owing to experimental difficulties and errors.

The Brinell hardness is still the property which appears, in this connection, the most important, the least uncertain, and the only one capable of being used on samples independently of their shape or dimensions. For these reasons the authors have adopted it to define the results of heat treatments. It should, moreover, be noted that for a given steel the heat treatment always modifies the mechanical properties, such as breaking stress, elastic limit, and hardness, in the same direction, and the elongation, the contraction, the impact resistance, and the angle of fracture on bending, in the opposite direction. A knowledge, therefore, of the variations undergone in respect of the hardness yields information

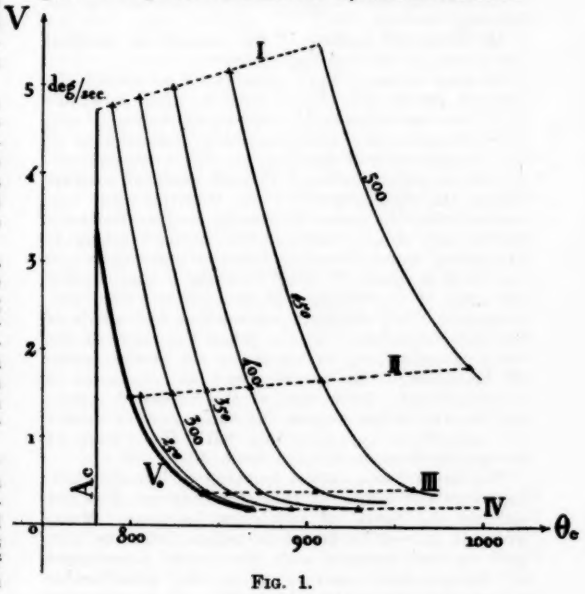


FIG. 1.

respecting those undergone by the other mechanical properties collectively.

The other physical properties are direct functions of the final state of the steel, that is to say, of the nature of its constituents. If, therefore, it becomes possible to define the latter, we possess a collection of data of the utmost value. For this purpose, however, the micrographic examination of the steel after treatment cannot alone be depended upon, for not only are the results first and foremost qualitative, and not susceptible of numerical evaluation, but they are also subject to considerable differences of interpretation, varying with the individual operator and his training and experience.

The state of the steel is, however, the immediate result of the transformations it has undergone during cooling, so that a quantitative evaluation of the intensity of these transformations during cooling affords a means of defining the final condition of the steel. The authors then proceed to recapitulate briefly the relations which exist between the transformations of a steel during cooling and the resulting constitution.

The plotting of a diagram of characteristic curves for heat treatments comprises a considerable number of experimental determinations forming a complete heat-treatment research on steel, of which investigations hitherto published afford no parallel. The most important of these curves, the curve showing the limit of annealing or the curve of the commencement of hardening, is one which can be plotted with considerable accuracy, as it can be decisively determined by three methods simultaneously—micrography, the transformation-point determination, and by ascertaining the hardness.

* Paper read before the Autumn Meeting of the Iron and Steel Institute, 1921

The authors have plotted characteristic curves for various types of steel selected amongst those most important industrially and most interesting from the variety of states practically obtainable, notably manganese steels readily susceptible of being hyperhardened, and nickel-chromium steels, and give the results obtained, up to the present, on one of the latter steels.

The nickel-chromium steel had the following chemical composition: C, 0.50 per cent.; Mn, 0.30 per cent.; Ni, 2.65 per cent.; Cr, 1.60 per cent.

The researches were made by the dilatometric method on samples 3.5 mm. in dia. and 50 mm. in length, and supplemented by determinations of the Brinell hardness.

Heating was effected in an electric resistance furnace with a very nearly constant rate of 250 degree-hours for all the tests.

Four methods of cooling were employed:

(1) Spontaneous cooling in air after withdrawal from the furnace.

(2) Cooling in a little metal muffle formed of a tube of baros (an alloy devoid of transformation states), heated together with the sample and air-cooled after withdrawal from the furnace.

(3) Cooling within the oven by interrupting the heating current, etc.

(4) Retarded cooling in the furnace by gradual reduction of the heating current.

In each instance the temperature on cooling decreased closely in approximation with Newton's law. On the other hand, the rate of cooling at any given temperature was practically independent of the temperature of heating, so that a typical cooling curve corresponded with each mode of cooling. Hence the employment of the "initial rate" to characterise the rate of cooling, and as Newton's law is very closely followed the points relating to any given mode of cooling distribute themselves in the final diagram V, (Fig. 1) along a line cutting the axes of the abscissæ at the surrounding temperature. This diagram summarises the whole of the determinations. It comprises the curve of the limit of annealing, or curve of the critical rates of hardening V_{60}, separating the region of the annealed states from that of the hardened states; and in the latter region the succession of curves of isohardness corresponding with the values of Brinell hardnesses varying from 50 to 500.

The isohardness curves relating to hyperhardening were not taken, so that this diagram does not exhibit the curve of maximum hardness. Moreover, it cannot be hoped to collate into one plan and on one common scale the entire appearance of characteristic curves, given the considerable range of cooling rates obtainable. It is necessary to limit the inquiry, in the first instance, to the most useful and most serviceable portion, for each steel. Even within these limitations the diagram of characteristic curves furnishes a collection of facts as to heat treatments incomparably superior to the often somewhat inchoate collection of numerical data hitherto accumulated in connection with the heat treatment of steels. Very often the basal considerations relating to mass and rate of cooling cannot be deduced from these observations, or expressed numerically, so that it becomes impossible to foresee what modifications may be required when the size of the pieces or the nature of the cooling medium is changed.

Numerous and important researches have now supplied data as to the cooling capacity of liquids and gases, and in order to apply them to practice there should now be plotted, with no less accuracy, and for each type of steel, the curve showing the relationship between the rate of cooling and the effect of treatment, taking into consideration, more particularly, the part played by the second of the fundamental variables—the temperature of heating.

It is to the questions raised by the latter problem that the plotting of the characteristic curves can supply answers, as they combine, in a readily utilisable form, all the data furnished as to heat treatment and are the only means of ascertaining, with any degree of precision, the hardening capacity of a given steel.

In their Paper the authors take into consideration only the influence of the two fundamental variables, temperature of heating and rate of cooling, on the results of heat treating a steel of given chemical composition. But, given these factors, the effect of treatment depends on other secondary factors: the law, and period of heating, and the original structure of the steel, the final state being a resultant of all its previous heat-treatment history.

The characteristic curves are not therefore strictly applicable except when the latter factors are constant, which might lead to the belief that their signification and utility must be correspondingly restricted. Without, however, entering into details, it will suffice to observe that the original state, the result of the previous heat-treatment history, can be reduced to a typical form by preliminary heat-treatments, and that, besides this, the perturbations which may be introduced may in many instances be entirely obviated by an appropriate selection of the law and duration of heating. In other words, in this group of secondary variables it is possible to so arrange matters that some of them will destroy the effect of others, and that the thermal behaviour of the steel shall agree with the data given by the diagram of characterisitc curves of heat treatment.

Does the Critical Point Depend on the Strength of the Magnetising Field?

By Kotaro Honda.*

(Summary.)

The author remarks that it is generally accepted that the critical point or A2 transformation point is not affected by the strength of the magnetising field. By the critical or A2 point is meant a temperature at which ferro-magnetism vanishes, or at which the substance changes from the ferromagnetic to the para-magnetic, but not the point at which the change of magnetisation, or the evolution or absorption of heat, is a maximum, as usually taken by metallurgists. Numerous experiments previously made for the determination of the critical point were mostly made with the magnetometer, and hence its determination was not sufficiently accurate. The strength of field was usually varied up to several hundred C.G.S. units, and within this range, and according to the accuracy attained, the critical point was practically found to be independent of the strength of field. For an accurate determination of the critical point in different magnetising fields the author considers it is necessary to use an apparatus of higher sensibility, such as a torsion-balance, with which he carried out the investigations referred to in the Paper.

Summing up the results the author arrives at the conclusion that the critical point is not affected by the magnetising field. The magnetic or A2 transformation is very probably a progressive change going on in the molecules themselves with the rise of temperature, and the change of magnetisation is only one aspect of this internal transformation as revealed magnetically. The critical point of such an internal change will not easily be affected by an external factor, such as a magnetic field.

LARGE CONTRACT FOR HUME PIPES.—The Hobart *Mercury* reports that the Hume Pipe Company (Australia), Limited, has secured a contract from the Government of South Australia, amounting to £3,000,000, for the laying of pipes over an area of 130,000 acres, bordering on the Murray River, between Murray Bridge and Adderley. The adoption of the principle of reinforced concrete piping, it is reasonably claimed, will do away with the serious loss of water similar to that consequent upon percolation and evaporation in connection with the open channels which run through the older areas of settlements in South Australia and Victoria, and a saving to settlers is held to be proportionate. When the contemplated works are completed, it is estimated that the total loan expenditure of the South Australian Government in this connection, exclusive of clearing or grading, will be £6,000,000. This scheme has been worked out under the direction of the Department of Agriculture and Mr. S. Mackintosh, Director of Irrigation.

* Tohoku University, Sendai, Japan.

The Shipping, Engineering and Machinery Exhibition.

The exhibition which opened at Olympia on the 7th inst., and will remain open till the 28th inst., will be found of a particularly interesting character, embracing as it does practically every section of the engineering industry, whilst it is not dominated by any one section. There are quite a number of exhibits of more or less direct interest to the foundryman. The moulding machines shown are sufficiently novel to warrant careful inspection, and this also applies to the sand blast and sand-mixing plant. On several stands there are exhibits of castings in iron, and in this section the span castings are of special interest, while non-ferrous metal and also die castings are a feature. In a word, the exhibition has a distinctly educational value to all directly or indirectly connected with the engineering industry. We append brief notices of those exhibits more particularly of interest to the foundryman.

THE BRITISH OXYGEN COMPANY, LIMITED, London, is the oldest and one of the largest producers of oxygen in the world, and the pioneer of the oxygen industry and also of the high-pressure cylinders system. At the present time their works throughout the United Kingdom are capable of producing over 2,000,000 cub. ft. of oxygen per day, and on completion of their other works (now in progress) their output will be increased to 3,000,000 cub. ft. They have a very comprehensive display of all their well-known manufactures—of injector blowpipe for oxy-acetylene welding; oxy-coal-gas lead-burning; oxy-acetylene metal cutters, both hand and machine controlled and for all thicknesses up to 18 in.; Endurance regulators in great variety, for all purposes and pressures; high-pressure valves, both for cylinders and gas mains; cylinders of various sizes, both for medical and industrial purposes. Demonstrations are given in oxy-acetylene welding, oxy-acetylene metal-cutting and lead-burning at frequent intervals. They also have on exhibit specimens of their special make and design of gas or air compressors, both single-, two-, and three-stage, capable of compressing up to 2,000 lbs. per sq. in.; also their special design of cylinder testing plant for registering expansion or permanent stretch, together with a variety of other specialities.

JAMES WALKER & COMPANY, LIMITED, London, are showing patent Lion steam and hydraulic packings, Golden Walkerite jointing, Emerald expansion gland packing, Wallico cone-gauge glass rings, and other descriptions of packings, jointings, and india-rubber goods for mechanical purposes.

THE POWER PLANT COMPANY, LIMITED, West Drayton, are showing some very special specimens of the gear-cutter's art in its most advanced form. A number of double helical wheels and pinions will be seen, and it should be noted that they are all of the continuous tooth type, the two helices joining at a sharp apex. These wheels will bear the strictest examination both as regards finish and accuracy. A combination set of spurs and triple helical bevels, with hand-wheel for operating, are shown, and perhaps of greater interest still is a 60 to 1 single-reduction set, comprising one-tooth pinion and wheel with 60 teeth. It is not known whether a single-tooth pinion has ever been produced before and made to work as this particular one. From a scientific point of view this will be one of the most interesting specimens of gear-cutting in existence. A number of single-reduction high-velocity gears, complete with their cases, and with the covers of the cases raised so that visitors can make a close inspection of the sets. Another interesting exhibit is a 500-h.p. magnetic clutch, coupling and brake combined. This is mounted up so that it can be operated electrically, and it will be seen that when the clutch declutches the brake simultaneously comes into operation, thus ensuring immediate stoppage of the machinery in case of necessity. A number of special models are to be seen on the counter—testing devices for gears, which go to exhibit the high degree of accuracy aimed at and obtained by the Power Plant Company in their works, etc.

REAVELL & COMPANY, LIMITED, Ipswich, are exhibiting five different types of compressors—three types suitable for auxiliary work on Diesel-engine ships, a three-stage quadruplex machine for fuel injection for land-type Diesel engines, and two single-stage quadruplex compressors suitable for shipyard work where compressed air is required for operating pneumatic tools. The three machines for auxiliary purposes are:—A marine auxiliary compressor, direct coupled to a Laurence Scott electric motor: This compressor is of the makers' patent three-stage vertical marine type, and is on the enclosed, forced lubrication system. The particular machine exhibited has a piston displacement of 110 cub. ft. per minute, and is suitable for a continuous working pressure of 60-70 atms. An auxiliary two-stage compressor, exceptionally suitable for charging purposes: This unit consists of a horizontal two-stage compressor, direct coupled to a Petter Junior engine and mounted upon a combination bedplate. The compressor has a piston displacement of 8 cub. ft. per minute and is constructed for charging up to a pressure of 60-70 atms. The third exhibit is a small auxilary compressor known as the "G.E.S." type. It is designed as either a power- or hand-driven machine, and for pressures not exceeding 250 lbs. per sq. in., this machine being suitable for charging the air starting bottles of gas, oil, or semi-Diesel engines. The three-stage quadruplex compressor exhibited is provided with a segmental facing by which it is attached to a similar facing on the Diesel engine bedplate, and is for fuel injection, and is the simplest and most efficient machine for such purposes. Of the two single-stage quadruplex compressors exhibited, both are suitable for pressures up to 120 lbs. per sq. in. One has a piston displacement of 386 cub. ft. per minute, and will be exhibited complete with bedplate and fast and loose pulleys. The other machine has a piston displacement of 151 cub. ft. per minute, and this machine will be arranged upon a combination bedplate and driven by means of a short belt and jockey pulley from a Crompton electric motor. Both of these quadruplex machines will be running during the Exhibition.

THE UNIVERSAL SYSTEM OF MACHINE MOULDING AND MACHINERY COMPANY, LIMITED, London.—This exhibit of moulding machinery comprises:—Several new types of power and hand moulding machines in operation; assembling machine for accurate closing of the mould and for pushing the mould completely through the box, enabling casting without boxes, in operation; hydraulic pumps and accumulators in operation; examples of pattern plates, stripping plates, and core-boxes made in metal without machining; sand preparation plant; foundry sundries. The D.F.4 moulding machine rams the top and bottom boxes simultaneously, withdraws the pattern plate, closes the boxes on the machine, and pushes the complete mould through the boxes, thus enabling casting without boxes. Examples of pattern-plate and stripping plate making by the company's patented system, which enables the foundry to make their pattern plates, stripping plates, and coreboxes in metal without machining them, thus making the foundry independent of the machine shop, etc.

THOMAS & BISHOP, LIMITED, London.—This exhibit shows two belts, one treated with "Cling Surface" and one untreated. The treated belt runs slack and delivers more power than the tight belt. This is clearly demonstrated to all those who are interested. The preserving qualities of "Cling Surface" are also demonstrated. "Permac," the jointing material in powder form: Tests are given of joints made with "Permac" where pressure is applied immediately the joint is made. Proofs are given that "Permac" jointing material is suitable for joints of marine and other engines, turbines, internal-combustion engines, cylinders, receivers, feed-water heaters, radiators, condensers, steam, gas, water, toluol benzol, oil, acid, ether, and alcohol plants. "Flexo" lubricating greases are shown in nine different densities, a special density for each purpose; Gale's commutator compound, a composition specially interesting to all users of electric motors: "Flexo" belt hooks, etc.

A1 MANUFACTURING COMPANY, Bradford.—This exhibit of resistance welders is one that should be particularly noted. Their range of machines is

wide in each one of the natural divisions of the work, as they manufacture eight standard sizes of spot welders, four standard sizes of seam welders, and 10 standard sizes of butt welders, in addition to which they have several standard sizes of slung welders, for welding hairpin windings of stators, and four standard sizes of rivet heaters, and also make a variety of special and standard jigs, enabling the process to be adapted to the various requirements of the exceptionally wide range of manufactures that resistance welding can be applied to. The exhibit which they are making is, we believe, the largest and most comprehensive that has ever been made at any exhibition of this type of machine, and includes spot welders, seam welders, butt welders, and rivet heaters. A very unique and attractive feature of the exhibit is that the panels of the fence around their exhibit are made up entirely of a great variety of applications of welding—spot welding, seam welding, and butt welding. Samples have been so ingeniously contrived as to form particularly attractive panels. Special attention is drawn to the butt welding of the angle irons that form the frame of one of these fences. The mitred right-angle is very noteworthy. Special attention is drawn to the somewhat remarkable examples of seam welding. Drums are shown completely made, and pipes, one up to 6 ft. in length, welded on these machines. These latter pipes are turned out complete at a very high speed of one a minute. The table on which they have a few odd samples exhibited is particularly interesting also, as being an example of the practical application of welding in the manufacture of light furniture—a particularly economical method. As these machines are all for operation by unskilled labour, for repetition production, under the existing necessity for economy and for quick production, the exhibition is of special interest, and the skill shown in the designing of jigs for adaptation to customers' requirements is very creditable.

THE LEA RECORDER COMPANY, LIMITED, Manchester.—Included in this exhibit is the Lea patent coal meter. Various types of these meters, which have been specially designed for the measurement of coal *as it is burned*, are shown fitted to a working model of a Babcock-Wilcox chain grate stoker. These meters, which can be fitted in almost any position relative to the chain grate, automatically count up the coal consumed, irrespective of speed of grate or thickness of fire. Experimental weighing apparatus designed to demonstrate the fact that a cubic foot of large coal weighs exactly the same as a cubic foot of small coal. Boiler feed-water measuring apparatus, consisting of compact-type Lea indicating, recording, and counting machine, having a capacity of 30,000 lbs. per hour, arranged in a self-contained manner, having combined V-notch measuring tank and hot-well. This apparatus is suitable for fixing in the pipe-line between an overhead storage tank or water supply and the feed pumps. The flow through the V-notch is automatically controlled by means of an equilbrium valve and float in accordance with the demands of the feed pump, so that the hot-well end of the tank is kept full of water at all times. Standard Lea recorder, measuring the flow of water over a rectangular weir, and illustrating the application of these machines for the measurement of large volumes of water, such as water supply, streams, sewage, etc.

AUTOMATIC & ELECTRIC FURNACES, LIMITED, London, exhibit Wild-Barfield automatic electric furnaces for the correct and automatic hardening of carbon steel. Standard furnace No. 8R is designed for tools, drills, dies, springs, etc., which are suspended in the furnace. Standard furnace No. 8F designed for small articles, such as needles, fish-hooks, small taps, etc., which are placed in trays on the floor of the furnace. Standard furnace No. 6LR, designed for long articles, such as camshafts, taps, reamers, broaches, gun barrels, etc. All these furnaces operate with the well-known Wild-Barfield indicator, which announces to the operator the exact moment when the charge reaches its critical temperature. All the equipments can be effectively operated by unskilled labour. Running costs are low and upkeep expenses negligible. At one penny per unit it costs £1 14s. to harden a ton of steel. The furnaces are handsomely finished in polished aluminium, with solid cast ends and doors, and indicating instruments, switches, fuses, etc., are mounted complete on an angle iron frame. A special safety device, which cuts off the heating current should a temperature dangerous to the windings be accidentally reached, is an integral part of each equipment.

LEEDS ELECTRICAL CONSTRUCTION COMPANY, LIMITED, Leeds, are showing the following:—"Lecfur" automatic electric rivet heaters, R.H.3 type and R.H.4 type, suitable for heating all sizes of rivets up to 1¼ in. dia. R.H.4 type is exhibited for the first time. "Lecfur" electric resistance furnaces, type R.1.S. twin chamber, tilting type, suitable for the hardening and tempering of carbon and alloy steels, complete with switchgear and pyrometer equipment. These furnaces are suitable for operation on either A.C. or D.C. circuits. High-temperature electric furnaces for working temperatures up to 1,400 deg. C. These are suitable for the heat treatment of alloy steels. The muffles or heating chambers are of special refractory material of high thermal conductivity and low co-efficient of expansion. They are mechanically strong, and are capable of standing continuous working temperatures up to 1,600 deg. C. without distortion or cracking. An important feature in connection with this special refractory material is that it does not soften even at elevated temperatures. This prevents the possibility of the metal in the furnace sticking to the muffle, which is a source of trouble with certain refractories at present used in furnace construction. "Lecfur" resistance furnaces, the bottom, top, and sides of the muffles are uniformly heated, resulting in a very uniform temperature. The metal is heated mainly by radiation, which ensures uniform heating of the metal under treatment, which is absolutely essential if it is desired to prevent distortion of the metal when quenching. Replaceable mica windows are fitted in the furnace doors, which allow the contents of the furnace to be inspected without opening the furnace. In the construction of "Lecfur" resistance furnaces special heat insulation is provided to reduce radiation losses to the minimum. A temperature regulation of 25 per cent. is provided for with "Lecfur" standard furnaces, but other regulation can be given to meet special requirements. Amongst other exhibits on the stand are thermostats and circuit breakers, special refractory muffles, samples of hardened and tempered steel wire and strip, treated by the "Lecfur" patent process. Also samples of non-ferrous metal wire annealed by "Lecfur" patent continuous process.

THE PREMIER ELECTRIC WELDING COMPANY, LIMITED, London, are showing their latest designs of electric welding plants, both of the engine-driven and motor-generator type. The two plants exhibited are of the single-operator type, the engine-driven plant consisting of a special 4.4 kw. electric welding generator, driven by a 10-h.p. internal combustion engine, the generator being provided with a separate exciter, and the plant equipped with reactance, switchboard and the usual electrical fittings. The motor generator set is of a generally similar design, but driven by a 7½-h.p. electric motor of suitable voltage. Electrodes: Samples of the latest types of "Premier" electrodes are exhibited, these including: General service, for the welding of mild steel, wrought iron, etc.; cast iron; high carbon, for use where a hard metal deposit is required; manganese steel, suitable for the welding of tramway points and crossings. Actual welding demonstrations are given by the Premier Company throughout each day as desired, and special demonstrations can be arranged by appointment. One of the latest types of spot-welding machines is also shown on the stand. The machine is fitted with regulators giving various welding speeds, so that graduations suited to a large variety of work may be obtained. The plant is water cooled, and designed to give perfect cooling and efficient results. The hard drawn copper jaws are so designed as to readily and easily replace, and these can be made in various shapes according to requirements. The transformer embodied in the machine can be wound to suit any single-phase alternating current from 40 to 60 cycles and from 100 to 500 volts. In the case of a polyphase supply the machine can be connected up to one phase of the circuit.

Moulding a Surface Condenser.

By J. Gerrard.

Loam moulding is the safest method of making castings that has yet been found, and, though still in its infancy, it can be asserted that where large castings are required in any quantity, providing they are given into the hands of a practical man, it is by far the cheapest.

It is a fact that at the present time the most important castings for all classes of engines which have to withstand great pressure are generally made in loam. Amongst these may be cited:—Cylinders of any consequence for turbines, corliss, slide valve, gas, and steam engines, condensers,

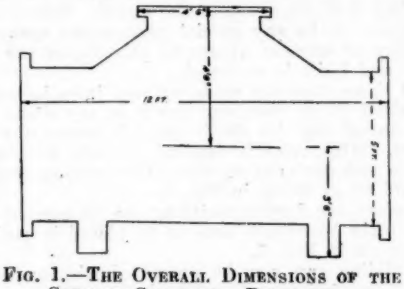


FIG. 1.—THE OVERALL DIMENSIONS OF THE SURFACE CONDENSER DESCRIBED.

generating casings, pumps, etc. The term loam moulding implies that the moulds are made by the use of bricks and loam as distinct from sand.

The utility of loam moulding can be gauged by the fact that moulds have been built up for the making of a casting 9 ft. 6 in. dia. in the body, about 11 ft. across the feet, and having a depth of 6 ft. 6 in. in less than four days by two men.

The moulding of the ordinary type of surface condenser presents many interesting features. The one shown in Fig. 1 is 5 ft. dia. For the moulding of such a casting almost every foundry has its own method, especially is this so with regard to the building of the core.

The branch cores often are made loose and bolted to the body, or otherwise placed in position after lowering the bottom half of the cope over the core. In the latter case a seating has to be made on the bottom plate, which must be plain.

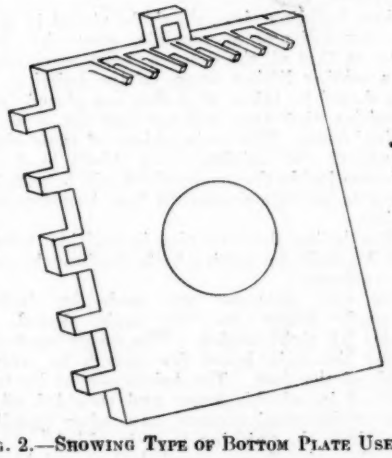


FIG. 2.—SHOWING TYPE OF BOTTOM PLATE USED.

A joint having to be made at the bottom, the mould is parted from this point.

As opposed to the usual method of ramming up loam moulds, a simple method of making castings this type without having to resort to the system of ramming, will be outlined.

Before any actual moulding can take place a spindle at least 16 ft. long is necessary; this must fit into a socket at the base and must be held firmly in position at the top. After ascertaining that the spindle and arms are suitable, the bottom plate on which to commence building should be made rectangular and large enough to allow about 9 in. of brickwork beyond the extreme points of the casting, with the addition of an extra 3 in.

The dimensions of the bottom plate would be then 10 ft. × 7 ft. 6 in. and made in a manner as shown in Fig. 2.

As this is the foundation of the whole structure it is essential that a good sound plate at least 4 in. thick should be used.

Provision has also to be made in this plate for bolting or binding the whole together, and for a casting of this size three or four bolts along each side and one at each end would be necessary. Plates of this character are cast open, and the example, Fig. 2, shows a number of upright prods on the plate; though shown only at one end they are continued completely round, and it is on this account that the extra 3 in. beyond the 9 in. of brickwork is required.

These prods, which are 3 in. × 1½ in., should be made as round as possible. They can vary in length, according to the amount of strain they will have to stand.

At the bottom of such a casting, they should not be above 12 in. long, made to taper slightly for convenience in moulding. The 3 ft. dia. hole in the plate is slightly eccentric, the reason being that from the centre of the body to the outside of the branch flange is 4 ft. 6 in., but only 3 ft. 6 in. from the outside of the feet.

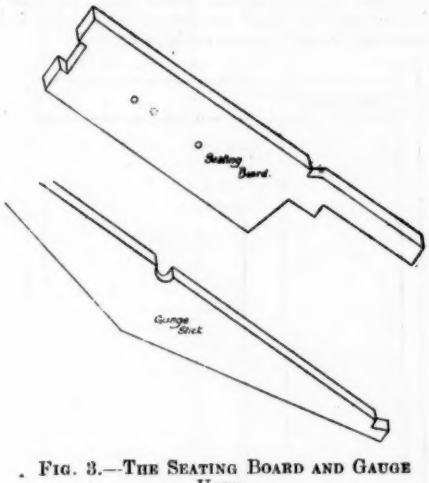


FIG. 3.—THE SEATING BOARD AND GAUGE USED.

By placing the spindle exactly in the centre of the 3 ft. hole, the building is equalised, resulting in exactly the same amount of brickwork beyond the extreme points of the casting being required. After fixing the plate and spindle in position, the first board needed is the seating board, as it forms the first for the body core and also the face of the bottom flange. The thickness of this flange can either be formed by the laying-on of wood flanges in segment, or it can be formed with the seating board by striking-up the flange thickness by the use of a finger fastened to the seating board.

If any quantity of these castings are required it is advisable to use the wooden flange segments, which must be cut in such a manner as will allow the moulder to draw them out from the inside.

This seating board would require to be made after the manner shown in Fig. 3, fitting flush with the spindle both above and below the arm. Many foundrymen imagine that an economy results from using almost any type of board, even though it should not reach the spindle by a foot.

The extra time which is taken in setting such boards does not compare with the time saved by using full-length boards.

Gauge sticks, preferably double-ended ones, as shown in Fig. 3, should also be used to prove the accuracy of the board.

In setting the seating boards on which the cope has to be built, it is advisable to set them about 1-16 in. larger than the gauge.

After bricking up to the top of the flange and the finishing loam applied, this seating board can

be taken off. This seating (Fig. 3) need not be completely bricked up, as nothing more than a full-length brick is required for a core point. Provision can also be made in this seating for the marking out of four centre lines, taking the centre of the two end snugs in the bottom plate as a guide. These centres can also be marked with a chisel point in one of these snugs, and in case any-

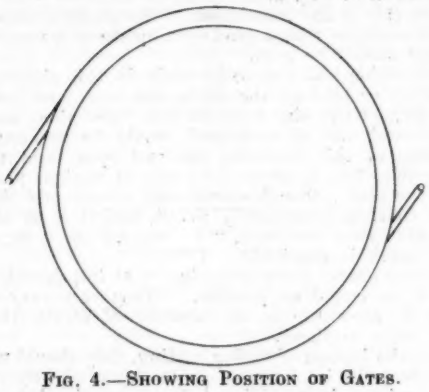


FIG. 4.—SHOWING POSITION OF GATES.

thing should happen to disturb those marked inside, there always remains this one from which all other centres can easily be found.

After the removal of this first board it is advisable that the seating be taken care of, and the point should be filled up either with loose bricks or any other easily removable material.

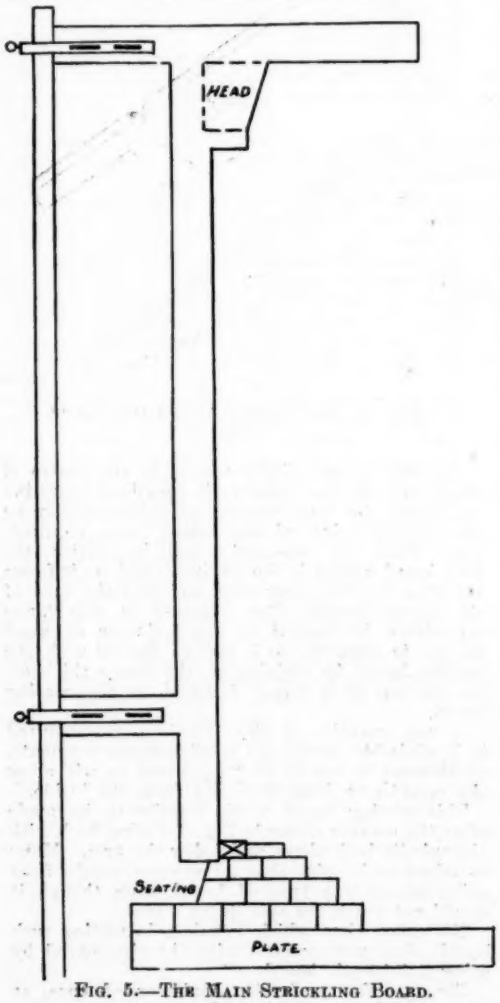


FIG. 5.—THE MAIN STRICKLING BOARD.

The whole of the outside can now be filled in, bringing the building up to the level of the flange, and just leaving sufficient space for two gates in the outside edge of the bottom flange, and placing the down gates for these as near the centre lines as possible, by using the centres at right angles to the feet. This outside building can be carried out without the use of the main board, by placing the bricks exactly flush with the inside edge of the prods, special care being taken around the gates. The best practice is to lay pieces of plate immediately behind the gates the whole of the way up.

One of the best methods of placing in the gates is to make them in cores, which, if given a coating of tar, will remain dry for long periods. Without such a coating they become soft by contact with the loam.

Gates about 1¾ in. dia. are quite large enough for this casting, when using only two down gates set in a position exactly opposite each other.

There is no necessity to use these cores the whole of the way up, but only the in-gates—the pegs for down gate being set in the cores, which are rubbed to fit the sweep of the mould. Where there happens to be any special precautions necessary, a piece of core can always be placed over the gate peg and built in as usual.

If these cores are made without irons in lengths of about 16 in., they can be cut to any shape, and the use of pegs for the in-gates is almost unnecessary. This remark applies equally as well to green and dry sand moulds. The position of gates would be as shown in Fig. 4.

Before any further building can be carried out, the main board will have to be placed in position as shown in Fig. 5.

Building can now be proceeded with as far as the tops of the prods, with the exception of two places, which must be left open down to the top side of the flange segments. These spaces are for the purpose of admitting of two supports for holding the branch pattern in position. These supports are made of rough timber and fastened to the lower half of the branch pattern, all screws being put in from the inside. They should be attached in such a manner that when placed on the top of the flange segments the top side of the half branch pattern reaches a point exactly level with the centre line, which should be indicated on the main board, as should all main body centre lines, so that anything misplaced during building can easily be rectified.

Before building beyond the prods a building ring must be laid-on, exactly the same dimensions outside as the bottom plate, and all the centre line snugs cast on with the 6-in. sq. holes, but this rise need only be made the whole of the way round, about 9 in. wide.

These building rings should be placed in as near the perpendicular as possible over the bottom plate, so that all the 6-in. sq. holes correspond.

In adding lifting snugs to the building rings, care should be taken that they are placed in such a position that they will not foul the bolts when bolting down. The main object of these rings is to support the building, and chiefly to form an enclosure inside the prods, which will be sufficiently strong to prevent the mould from bursting during casting.

After laying this first ring in position, provision must be made for setting both the branch and the feet patterns.

The feet patterns are made by fastening a small finger to the main board, and exactly at right angles. The finger must stand beyond the main board far enough to cover the width of the feet. The bricks should be laid to within ¾ in. of this finger and strickled off with loam in the usual manner, and, after standing a short time, the finishing loam is added.

As there is often a good deal of weight to be borne by this bed, it is advisable that it should be well dried before fixing on the patterns.

These patterns should be set in their exact position by means of a template made in the manner shown in Fig. 6. The template is laid against the spindle, and the centre of the template is worked round the spindle until it is brought exactly over the centre line which was marked in the seating at the bottom, this position being found by means of a plumb line.

The patterns should be fastened to the template until sufficient building has been erected around them to prevent them being displaced.

The template can now be removed and the main board brought round to the position over the centre line between the feet patterns.

The branch pattern can afterwards be set in position by placing the two supports in the spaces left during building as already mentioned. The top side of the branch pattern is held firmly in position by the means of another template similar to the one used for setting the feet patterns.

This template should not be moved, except when the spindle is taken away for the addition of building rings, until the centre line is almost reached. The branch patterns need only be skeleton patterns.

Building can now be proceeded with until the centre line is reached, the building rings being added in the manner already described. Care should be taken to prevent building the branch pattern out of shape; this can very easily happen

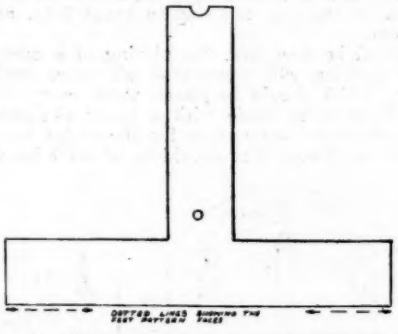


FIG. 6.—TEMPLATE USED FOR THE SETTING OF FEET PATTERNS. THE DOTTED LINES SHOW THE FEET PATTERN FACES.

with a skeleton pattern. The bricks should be kept about an inch below the centre line to allow the joint to be made. This can be done by using another finger of sufficient length to reach the corners of the building and strickling off in the manner described for striking up the beds of the feet patterns.

To prevent the building collapsing when the feet patterns are withdrawn a grating is built in, being laid on a loam bed above the patterns. This grating is made sufficiently large to reach a point which will give bearing on the building rings, the inside edge of the grating being made to fit the sweep of the mould.

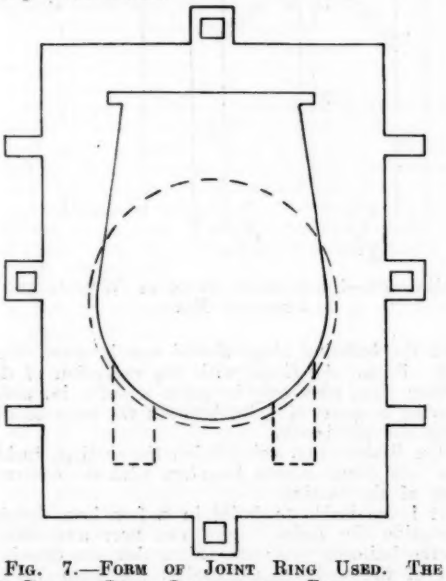


FIG. 7.—FORM OF JOINT RING USED. THE DOTTED LINES INDICATE THE PARTS OF THE CASTING UNSEEN AT THE JOINT.

The joint having been made from which the mould is divided, a good sprinkling of parting-sand should be applied.

A bed of loam is next laid on the joint and brushed over with clay wash. On this is firmly bedded the joint ring, to which also a good coating of clay wash should be applied on the underside.

As this joint ring is an entirely different one from the plain building rings, a detailed description may be of use. It should be made exactly the same dimensions on the outside as the bottom plate, but instead of being only 9 in. wide it must be made in such a manner that it will be of sufficient strength to carry the whole of the weight in the top half of the mould.

It must be made to fit the sweep of the mould, and also to clear the extreme points of the casting by at least 2 in. As some of these points cannot be seen on the joint of the mould, they must be provided for when marking out the shape on the bed when making the ring.

This can easily be accomplished by laying the templates on the bed, which gives exactly the size of the casting, but, beyond this, allowance must

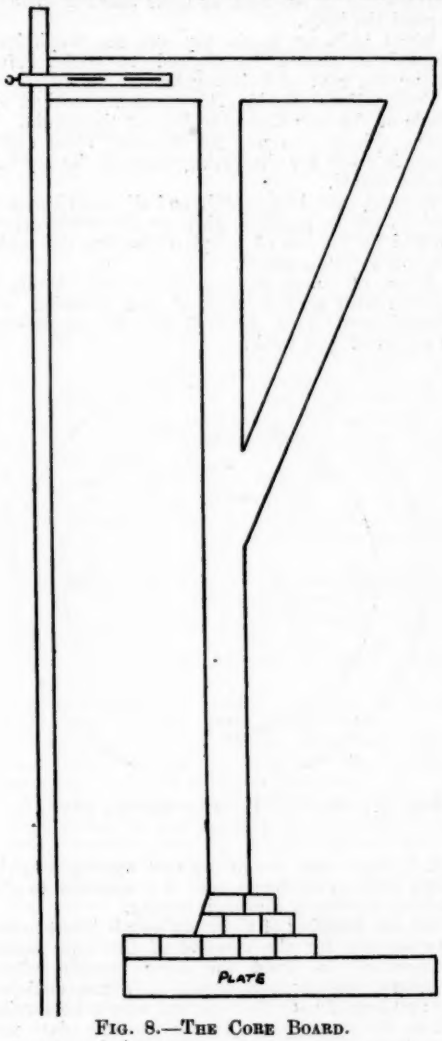


FIG. 8.—THE CORE BOARD.

be made for contraction, and, to gain a clearance of 2 in., it will be necessary to mark the ring out at least 2½ in. from the template size. This will allow 1 in. for contraction.

The joint ring (Fig. 7) shows the form of the inside of the ring, and the dotted lines indicating the parts of the castings which are not seen on the joint.

As there will be a space between the inside of the ring and the main board the brickwork in this space will have to be carried by small gratings made to fit between the ring and board. Staples should be cast in these gratings sufficiently long to stand through another set of larger gratings, which should reach from the prods on the back side of the ring to the point just clear of the board by about an inch.

These small gratings can then be fastened by cottering to the larger ones.

If this building is carried out in this manner it is practically impossible for accidents to happen. Building can now be continued by laying in an extra grating above the branch flange until it reaches to the body of the branch pattern. This grating will then support all the building above,

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but in cases of castings which taper sharply from the flange to the body it would be necessary to put in an extra grating. The feet in the top half are covered by a grating in the manner already described.

When the building has reached a point higher than the feet and branch patterns the mould again assumes a circular form, this being continued to the top of the head, as shown in Fig. 5. To allow the casting to contract easily, a course of loam bricks should be built in immediately below the top flange, and also below the top feet.

After casting, the outside bricks can be taken out and these loam bricks can then be broken up and easily removed, this remark applying more particularly to the feet, as these stand a distance beyond the body.

When built up to the top and the rough loam applied, it should be allowed to stiffen before giving the coat of finishing loam.

Centre lines should afterwards be marked the whole of the way down the face of the mould.

The spindle can now be removed, when everything is ready for the lifting away of the top half of the mould.

It must then be finished, and all small bosses or facings set in position, this usually being accomplished by the use of templates having the centre lines as starting points.

When all these are set the mould should be treated with a thick coat of wet blacking and sleeked over. It is finished with the application of a coat of gum wash.

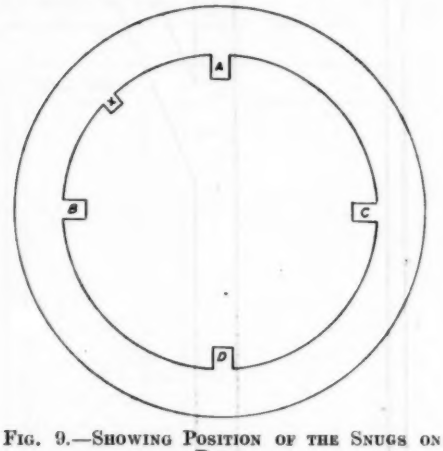

FIG. 9.—SHOWING POSITION OF THE SNUGS ON RING.

It is then ready for lifting and sending into the stove, and, to ensure success, it is essential to give all loam moulds a thorough drying.

For the building of the main core it is not necessary to wait for the removal of the cope before commencing to build the core, because, where necessary, another spindle can be in use, enabling the building of both the cope and core to be carried out at the same time. Another bottom plate will have to be used, but almost any kind will suffice if sufficiently large. The same seating board should again be used and a dummy seating struck up.

In striking up this seating, instead of setting the seating board larger than the gauge, as in the case of cope seating, it should be set 1-16 in. under size.

This will give ⅛ in. clearance, which will be found of great value when lowering the core into position. Fig. 8 shows a suitable core-board.

It is the usual practice to hold the bottom of the board firmly by means of a wooden clamp, made of two boards, fitting one each side of the spindle at one end, and each side of the board at the other end, and fastened together by a couple of set screws in the manner described for holding the board to the arm.

This body core having to be lifted, provision must be made for this purpose. A ring is made about 10 in. wide and 3 in. thick which fits inside the seating, leaving a clearance of ¼ in. all the way round.

Four snugs should be cast on the inside of the ring, in which staples can be cast, or they can be left solid, in which case short stirrups can be used fitting around the snugs in exactly the same manner as the uprights fit around the binders.* Fig. 9 shows the ring with snugs marked at A, B, C, and D, and a smaller snug at X.

After finishing the seating, and lining with wet parting sand or paper, a loam bed should be prepared, and the lifting ring bedded firmly down and clay-washed as described, the spindle having to be moved for this purpose.

On the point marked X in Fig. 9 a cast-iron wedge is placed, and should be about 9 ft. long and 15 in. wide, and tapered slightly both ways, the broadest parts being the top and the back or inside. It should have a face of no less than 3 in., nearest the casting, and should be set in such a manner that the board will clear by about 1 in.

The back of these wedges should be about 5 in. across at the top, tapering to about 3 in. at the bottom.

It will be seen that the placing of a wedge in this position will mean that all other building rings, which should be placed about every 18 in., will have to be made with a broad slot casting, due allowance being made for the wedge to fit in this slot. These slots should be about 7 in. wide,

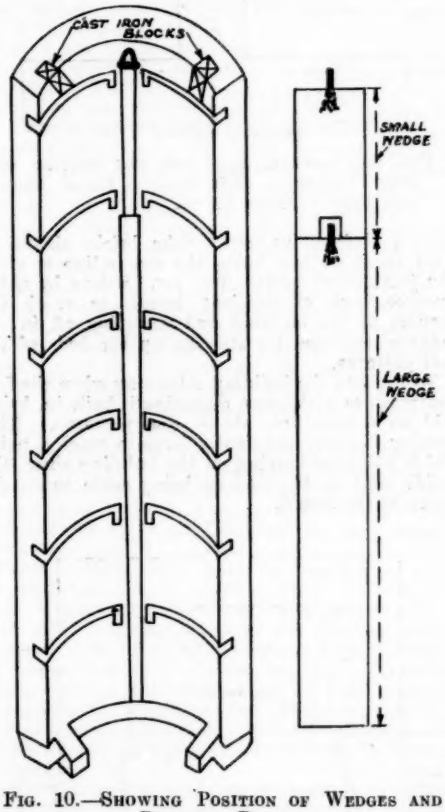

FIG. 10.—SHOWING POSITION OF WEDGES AND BUILDING RINGS.

and the building rings should not be more than 1 in. thick. All rings, with the exception of the lifting ring, need only be made about 5 in. wide, leaving a space of 4 in. between the edge of the ring and the board.

The lifting ring, being below the casting, inside the core print, cannot interfere with the contraction of the casting.

It is advisable to build in a few loam bricks alongside the wedge, laying one here and there, as the building proceeds, this makes the drawing out of the wedge much easier, the loam bricks giving way quickly under the pressure from the crane.

When built up to the top of the first wedge a second smaller wedge will have to be placed in position. This will reach to the top of the core, the small one resting on the top of the first, as indicated in Fig. 10.

After about every 3 ft. of building, the rough loam should be applied. When the top is reached and the rough loam is covering the brickwork, the mould should be tested by callipers, which will

* See "Foundry Pits," page 119, August 11 issue of "The Journal."

indicate how much finishing loam is necessary to bring it to the exact size.

If very little is necessary to get the correct diameter, it is advisable that the tapered edge of the board should not be used. By this method very little loam is added to the surface, practically all the loam applied for finishing purposes being used in smoothing over the rough places without increasing the diameter.

The board can then be taken off and the core allowed to stiffen for a short time, when the centre lines should be marked down the four sides of the core, from top to bottom. Where ribs or lugs have to be placed, provision for these should be made by building in loam bricks, which enables one to dig out a small space to admit the patterns, the spaces around these being afterwards filled in with stiff loam.

Provision must also be made for fastening the gratings for the branch, which is done by leaving a number of holes in the building, allowing of the passing of bolts through to the inside of the core, when they can be bolted back against the surface of the core and fastened to the building rings on the inside. These branch gratings are made to fit the sweep of the core, and a good row of stiff prods cast on, which should fit flush against the surface, this giving substantial bearing to pull against when bolting up the grating. Three gratings in each half would be plenty for a branch of this size, providing a broad one is placed just below the cores, which form the rib through the centre of the branch. Where these branch cores are very heavy it is a wise plan to place a couple of cast-iron bars through the body core, immediately above the broad grating just mentioned.

These bars should be fastened to this grating in a secure manner, and they should be made sufficiently long to reach from the outside of the branch to the inside edge of the building ring at a point farthest from the branch, passing right through to the opposite inside edge of the core. They should be in a position just above a building ring and resting on it by being packed "iron and iron." These bars can then be bolted down to the lifting ring, and in the case of a very heavy branch, provision for this should be made when making the lifting ring.

As some of these branch cores are almost as heavy as the body core the need for exercising care will be readily understood. The possibility is that the branch cores being so heavy on the one side may pull over the whole arrangement.

A level bed is strickled off inside the branch pattern, on which the cores forming the bottom of the rib are then placed. They are covered by similar cores, which are supported on the inside by means of studs giving the required thickness. The back side, or outside, rests on a print. Gratings, again, are laid on one of them immediately above this core, and fastened back in the same manner as those in the bottom half. When the top of the branch is reached the patterns can be removed, and the core dressed and blackened, rendering it ready for stoving.

The cope, during the meantime, will have been placed in the pit in the position it will occupy whilst being cast.

The feet cores can then be placed in position, and while the core is drying, the top plate, which should be of the same dimensions as the bottom plate, and having snugs in the same position, but with holes cast-in, through which the bolts can be passed, should be struck up and dried.

A number of holes for gates should be cast in this plate, immediately opposite the thickness of metal in the body, and a larger hole for risers. These gates will need to be all on one-half of the casting, otherwise the metal falling from the top would drop on the branch core, which would probably result in a scabbed casting.

The body core being thoroughly dry, another ring the same size as the lifting ring with four snugs, but instead of being solid, should have holes cast in them for bolting purposes. They should be placed on the top of the core, packed upon cast-iron blocks, laid on the top building ring as shown in Fig. 11.

Four strong staples should also be cast in this top ring, through which the hooks can be passed for lifting purposes.

The top and bottom rings should now be bolted firmly together when the core is ready for lifting, care being taken to have the shortest chairs on the branch side of the core.

This can then be placed in position in the bottom half of the mould, and whenever the thickness of metal cannot be seen, pieces of clay will be laid which will show the thickness when flattened out by the weight of the core.

This core needs to be set as accurately as possible, otherwise there will be trouble when placing the top-half of the cope over the core.

The top half of the cope is then set in position by the use of marks which are cut in the loam before the mould is first divided, the joint of the mould coming in the centre of these marks. If the thickness shown by the clays is correct, which can be seen when the cope is lifted out again, these are taken away and the cope placed finally in position.

In the meantime, a ring should have been made in which to build the runner. The ring is of metal, about 6 in. wide, with a row of prods on the outside edge, and made sufficiently large to enclose both the runner and riser.

The top plate should be turned over, and this ring laid on top and the runner bricked up and again sent into the store to dry.

The top-plate is next placed in position, being set to centre lines. The top gates locate exactly over the thickness, and the two down gates made to correspond.

It is then ready for bolting together, but on the inside, the bottom print of the core will need to be made secure, and should be well stopped-in, and rammed up a short distance, which will prevent the metal getting away on the inside of the mould.

Provision should also be made for bringing a bolt right through the centre from top to bottom and bolted here in the same manner as the outside snugs are bolted together. The wedges should also be packed to prevent the metal forcing them inwards, this being quite simply carried out by placing clamps across the snugs in the building, against the small prods, and packing the wedges against these clamps.

Inside the 6-in. holes in the centre snugs four 4-in. sq. steel bars, reaching from top to bottom, should be placed, and should be firmly wedged on every side in each building ring. This finished and every joint made secure, the mould is ready for casting.

After casting and feeding it should be given a short time to allow it to become solid.

The centre bolt can then be taken out, and the loam brick covering the staple in the top wedge cut away, and the wedge withdrawn.

Any small wedges which might prevent the casting contracting should be taken out, and the main wedge removed, leaving an open space 3 in. wide at the narrowest point.

The moulder's work is then finished, but to allow the branch to contract easily, the building should be broken through right to the inside of the core from the back of the branch, all the core-irons being broken in this process.

The casting can then be left alone until sufficiently cool for handling with safety.

SOUTH AFRICAN TRADE.—Mr. W. G. Wickham, his Majesty's Senior Trade Commissioner in South Africa, is at present in this country on an official visit, and is prepared to interview at the Department of Overseas Trade from September 1 to September 16 firms who desire to obtain information as to trade possibilities in the Union of South Africa. Mr. Wickham will be pleased to meet manufacturers and merchants who may wish to consult him in regard to steps to be taken for opening up trade, and among the matters on which he is prepared to give information and advice are the general state of trade in South Africa, method of marketing and distributing of goods, terms of payment, rates of Customs duties, and general information as to openings existing for British goods. London firms who are desirous of consulting Mr. Wickham should communicate immediately with the Department of Overseas Trade, 35, Old Queen Street, London, S.W.1, quoting the reference 3092/T.G., and indicating briefly the subject on which the interview is desired. Mr. Wickham will subsequently visit some of the principal industrial centres of the United Kingdom.

XUM

Cast Iron for Automobile Cylinders.—Part II.

Metallurgical Consideration.—Within very wide limits, the character of the casting as regards general appearance and freedom from blowholes and like defects, is little influenced by the chemical composition of the cast-iron.

Pinholes and blowholes may in some cases be partly due to the presence of occluded gases in the cast iron, and from this standpoint the chemical composition might be considered as having some little influence upon the character of the casting.

The machinability of cast iron is largely governed by the chemical composition, and there is, as a rule, a great danger that castings of thin section and low silicon contents required for automobile work may be too hard for machining. The immediate cause of the hardness is the amount of combined carbon present, and it frequently takes the form of hard areas or spots in which the iron is white superficially, and oftimes throughout the whole thickness of the casting in those areas. The causes of hard spots and the local increase in combined carbon are often difficult to trace. They may occur as a result of too much coal dust in the facing sand or too wet sand. They can frequently be traced to the sulphur content of the iron, and this requires careful control, particularly in these days of poor quality coke.

The production of good, sound castings, apart from the character of the mould, is intimately associated with the temperature of the metal. It is fundamental to the successful production of the thin light castings required for automobile work that the metal be as hot as possible. This is particularly true with green-sand work, and within the limits of the ordinary cupola practice, the metal cannot be too hot.

Chemical Composition.—The chemical composition of cast iron for automobile engine parts is governed by the requirements, and these naturally vary according to the conditions which the various castings are called upon to withstand. A considerable amount of discussion has taken place on this subject, and it would appear that there still remains a great deal of systematic investigation to be carried out before any limits of composition of cast iron can be said to be the best for any particular purpose. Before even this can be thoroughly done the physical and mechanical properties required to constitute the best cylinder or the best piston ring, etc., must be definitely stated. This step is rendered extremely difficult by the possibility of such wide variations in the conditions to which the various parts are subjected in actual practice. For example, the actual temperatures attained in engines of the same design may vary in use, and in a like manner the rate of wear of a given cast iron may also vary in two engines of the same design according to conditions which are external to the composition of the iron. Quite a long discussion on this aspect of the question could be entered upon, but it will be readily granted that the fundamental requirement of the engineer and designer with respect to the composition is that it shall within practical limits be uniform.

The limits of composition called for in the British Engineering Standards Association's Specifications for Aircraft Cast Iron are given in Table I.

The two alternative compositions are essentially different in the limits of manganese and phosphorus, and this may be ascribed to the uncertainty of the influence, detrimental or otherwise, of varying quantities of these constituents. It is also required that ½ in. diam. test-bars, sand-cast, from iron to either of the limits of composition specified shall give a minimum ultimate tensile strength of 12 tons per square inch.

It will be noted that the maximum limit of silicon specified is somewhat lower than that frequently adopted for automobile engine cylinders, and quite a large proportion of engine cylinders cast to-day are more often in the region of 1.80 to 2.25 per cent. silicon. The lower values of silicon are, however, to be desired, and it will be evident that the value will have to be varied according to the actual thickness of the casting. In castings such as automobile cylinders, which are liable to considerable variation proportionately in different parts of the casting, the minimum thickness is to be considered in this connection. In air-cooled cylinders, for example, having extremely thin cooling fins, a higher value of silicon is required, otherwise slight chilling occurs on the extreme edges of the fins. This provision has been made in the aircraft specifications, which for air-cooled cylinders the maximum limit for silicon is raised to 2 per cent.

Semi-Steels.—The use of steel scrap in foundry mixtures for engine cylinders and other castings under the title Semi-Steel is now common practice. The use of steel scrap in this manner is a convenient method of obtaining a lower silicon and phosphorus iron. Very frequently, a lower total-carbon content than a normal pig-iron mixture is obtained, but this is liable to considerable variation according to the particular conditions obtaining in the cupola. When it exists, the lower total-carbon content is probably a distinct advantage, but the liability to considerable variation in this constituent is the great disadvantage of the use of steel scrap.

TABLE I.—*The B.E.S.A. Specification for Aircraft Cast-iron.*

	Water Cooled Cylinders and Pistons.		Air Cooled Cylinders and Valve Guides.	Piston Rings.	
Element %	A.	B.		Sand.	Chill.
C C. ..	0.50–0.80 per cent.	0.50–0.80 per cent.	0.50–0.80 per cent.	0.55–0.80 per cent.	0.45–0.80 per cent.
T C ..	2 70–3.50 „	2 70–3.30 „	2.70–3.50 „	3.6 Max.	3.9 „
Si. ..	1.20–1.80 „	1.20–1.80 „	1.20–2.00 „	1.8 „	1.8–2.5 „
S. ..	0.12 Max.	0.12 Max.	0.08 Max.	0.14 „	0.14 „
P. ..	0.80 „	1.1 „	0.80 „	1.0 per cent.	1.2 „
Mn. ..	0.35–0.80 per cent.	0.60–1.20 per cent.	0.50–1.20 per cent.	0.6–1.20 per cent.	0.4–1.2 „

In reference to cupola-melted semi-steels it should be emphasised that they have no special property conferred upon them by virtue of the use of steel scrap, nor does the resulting cast-iron partake of any of the essential properties of steel which, after all, are malleability and ductility.

As already indicated, freedom from distortion under heat and freedom from liability to cracking under ordinary conditions of usage, are two of the most important features to be taken into consideration in connection with the use of cast iron for automobile cylinders.

It is extremely probable that these two features are, to a large extent, interconnected, and these two features are receiving considerable attention from our investigations. Knowledge of the whole subject is extremely scanty, and investigators are confronted at once with the lack of any efficient means of determining the liability of cast iron to these defects.

Design.—When the structural characteristics of cast iron as outlined are considered, it will be appreciated that cast iron is an extremely brittle material and possessing practically no ductility, and the liability to cracking is very marked. The causes of actual cracking of cylinders in practice are many and various, and are probably due to more than one single defect.

One of the most commonly ascribed causes of the liability to cracking is the presence of internal stresses in the castings, particularly in castings of such a complicated nature as some of the water-cooled monobloc cylinder castings. In these instances the design of the casting often plays an important part. It is not possible to consider this in detail within the scope of this article, and it will suffice to say that there appears no doubt in the minds of both engineers and metallurgists alike that the adoption of one of the composite methods of cylinder construction is the ideal method of eliminating trouble from this source. (In addition it allows of other advantages.) In this connection it is of interest to note the remarks

of Mr. H. Pilling in a recent paper before the Cleveland Institute of Engineers on "Wear and Tear in Large Gas Engine Parts." In his experience, built up or composite cylinders gave no trouble, whilst cylinders of "one piece" design were liable to fracture.

There is very little actual data regarding the magnitude and disposition of internal stresses in cast iron, but it is a perfectly legitimate conclusion to draw that the actual cracking of cast-iron cylinder castings when they become heated in a large measure may be ascribed to the brittleness and lack of ductility of the material. This has led to the application of the impact test to cast iron with a view to attempting to determine the degree of brittleness of various grades of cast iron. In this connection the writer cannot help but feel that sufficient attention has not been paid to the indications of the transverse test, particularly to the study of the conditions under which the deflection is modified.

It will also be perfectly obvious that the ease with which cast-iron motor-cylinders fracture is partially connected with the considerable reduction in tensile strength at high temperatures. The results obtained by Meyer on the bending strength of cast iron, determined at different temperatures, are given in Table II.

The element which is most commonly associated with brittleness in grey cast iron and the liability to cracking and fracture is phosphorus. From a knowledge of its mode of existence in the cast iron as the hard, brittle eutectic, some idea of the origin of the view is at once perceived. Everyone is familiar with the extreme fragility of stove-

TABLE II.—*Showing the Influence of increasing Temperature on the Binding Strength of Cast-Iron.*

Temp. deg. C.	Bending Strength Tons per sq. in.	Inches Bend.
18	23.53	0.31
66	22.22	0.30
268	21.08	0.28
297	19.88	0.30
620	12.09	0.53
807	7.56	0.94
18	23.58	0.30
85	21.90	0.28
155	21.27	0.28
370	21.02	0.30
580	16.03	0.57
810	6.16	0.79

grate castings and many similar articles of ironmongery. These castings, which are mostly very thin, are usually cast in iron having a high silicon and high phosphorus content, very often over 3 per cent. silicon and 1.5 per cent. phosphorus. Such castings are extremely brittle.

In cast irons containing less silicon and less phosphorus—phosphorus in quantities up to 1 per cent.*—appear to have a very slight tendency towards reducing the impact value of cast iron at normal temperatures, and there is no data published regarding its influence at high temperatures. As was remarked in connection with the discussion of the tensile test, the influence of phosphorus is probably more pronounced in cast iron having a very close grain—a statement which is borne out by recent experiences with centrifugal castings.

It is frequently alleged, the high manganese tends towards increased brittleness and liability to fracture, and, unlike the phosphorus, it is of great difficulty to find some justification for this based upon our knowledge of its influence and structural existence. Keep made an exhaustive series of impact tests on samples containing varying quantities of manganese. In a series of bars having a practically constant silicon content of 1.5 per cent. he found that the increase in manganese up to a percentage of 3.83 produced practically on change in the transverse bending load, deflection or load and deflection on impact. These results would appear to disprove the statements that this element tends towards increased brittleness.

Annealing and Distortion of Cast Iron.

In many cases it is customary to subject automobile castings such as cylinders, pistons and sleeve valves to an annealing treatment previous to use in the engine. The object of this treatment is primarily to eliminate the possibility of distortion in the various parts when in use in the engine. The question of the origin of the distortion, which frequently results in the actual cracking of the part, is variously associated with the stresses present in the original casting and with the decomposition of the combined carbon resulting in the production of free carbon, which in its turn sets up the stresses which result in distortion. The question of the temperature attained by the various components of the cylinder during working is of considerable importance in this connection. The piston head probably is the hottest portion of the engine, and working under admittedly defective conditions, as cast-iron pistons may attain a temperature of over 600 deg.

TABLE III.—*Chemical Analysis (Before Heat-treatment).*

Test No.	CC.	Gr.	Tot. C	Si.	Mn.	S.	P.
0.0	0.78	2.75	3.53	1.14	0.31	0.04	0.45
2.0	0.88	2.71	3.61	1.16	0.30	0.04	0.45
3.12	0.65	2.83	3.48	1.44	0.49	0.17	0,84
4.15	0.75	2.69	3.44	1.47	0,50	0.17	0.84
5.10	0.62	2.74	3.36	1.58	1.02	0.13	1.04
6.13	0.38	2.66	3.04	2.69	0.33	0.15	1.40
7.16	0.39	2.69	3.08	2.69	0.32	0.16	1.45
8.14	0.67	2.48	3.15	2.46	0.36	0.16	1.32

C. in the centre of the head. At temperatures above this a considerable decomposition of the combined-carbon would be expected with the consequent volume changes and reduction in mechanical strength values. The reduction in the tensile strength of cast iron after heating to these temperatures has been shown by various workers.*

Some results obtained by J. E. Hurst ("Engineering," July, 1919), and shown in Tables III. to V., may be of interest in this connection.

TABLE IV.—*After Heat-treatment for a period of 100 hours.*

Test No	CC.	Gr	Tot C
0 0	0 54	3 02	3 56
2.0	0.90	2.47	3.37
3.12	0.23	3.20	3.43
4.15	0.70	2.78	3.84
5.10	0.50	2.88	3.38
6.13	0.10	3.06	3.16
7.16	0.14	2.89	3.03
8.14	0.13	2.92	3.05

In these experiments the samples were maintained at a temperature of from 575 to 600 deg. C. The bars used were ¾ in. square, the surface skin having been removed by planing down from the original 1 in. square section. From the results obtained it would appear legitimate to infer:—
(1) That it is possible for the combined-carbon to decompose on prolonged exposure to temperatures in the neighbourhood of 550 to 600 deg. C.
(2) That the combined-carbon decomposes more readily in the higher silicon content samples.

TABLE V.—*Brinell Tests Before and After Heat-treatment.*

Test No.	Before heat-treatment.	After heat-treatment.
0.0	212	207
2.0	228	196
3.12	228	223
4.15	228	207
5.10	255	217
6.13	179	196
7.16	207	217
8.14	241	170

(3) That in the higher silicon members of the series the combined carbon reaches approximately the same final value after heat-treatment, whatever the original carbon content.

The combined-carbons in the lower silicon content members of the series are somewhat erratic, which is difficult to account for. It does, however, appear that in the lower silicon samples the combined-carbon becomes increasingly difficult to decompose. This is a good reason for the adoption of lower silicon content materials.

In Table VI. the results of some measurements of expansion of two sample bars after heat-treatment at this temperature of from 550 to 600 deg. C. are given. It will be seen that there has been

*W. J. Keep, Cast Iron, 1902.

* Hatfield, J., I.S.I., 1907. Meyer, "Stahl und Eisen," Vol. XXVI., &c.

in this case an appreciable permanent expansion in all directions, the approximate average dimensional increase being about 0.35 per cent.

These two samples were subjected to heat-treatment for a period of 48 hours at the above-mentioned temperature. The expansion taking place was measured after allowing the specimens to cool in air. The specimens were then subjected to a further 41 hours at the same temperature, and it will be noticed that this further treatment did not produce any additional expansion.

Table VI.—*Results of Expansion Measurements.*

No.	Position of Measurement.	Before H.T.	After H.T. (1)	After H.T.(2)	Max. Total Exp.
C.1.	Length .. *End* (1)	1.740	1.750	1.748	0.010
	Breadth ..	0.4500	0.4520	0.4520	0.002
	Thickness .. *End* (2)	0.4505	0.4520	0.4520	0.0015
	Breadth ..	0.4500	0.4510	0.4510	0.0010
	Thickness ..	0.4505	0.4515	0.4515	0.0010
C.2.	Length .. *End* (1)	2.1120	2.120	2.120	0.008
	Breadth ..	0.44825	0.44975	0.44975	0.001
	Thickness .. *End* (2)	0.4495	0.4515	0.4515	0.0025
	Breadth ..	0.4485	0.4525	0.4525	0.004
	Thickness ..	0.4490	0.4510	0.4510	0.002

It would appear from these experiments that the adoption of some form of annealing process is justified in so far as the removal of the distortion due to the permanent expansion on heating is concerned.

Some further interesting results have been published by Rolfe.* In these experiments it was found that a gradual reduction in tensile strength and Brinell and Shore hardness numbers occurred with increasing annealing temperatures up to 550 deg. C. At about this temperature the tensile strength and hardness values commence to fall very rapidly, the tensile strength being reduced from 13 tons per sq. in. at 600 deg. C. to 11 tons at 700 deg. C. and the Brinell hardness from approximately 220 to 125. The impact values as measured by the Stanton method are included in these results, and it is to be noted that with the increasing temperatures this value rapidly decreases, reaching a minimum with a temperature of about 350 deg. C. This is followed by a gradual increase in value till at the temperature of 550 deg. C., at which the tensile strength commences to decrease rapidly, the impact figure reaches a value as high as the original sample before annealing. Some confirmation of these results has been obtained by the author using the Izod form of test.

The Pyrotip Heater, for Local Application of High Temperatures.

In the figures of Meyer, in Table II., it will be noticed that the bending angle increases considerably at the temperatures of 620 deg. C. in the one case and 580 deg. C. in the other case.

Still further investigation into this question is required, but it does appear on the face of it that the careful annealing of cast iron in the region of 550 to 600 deg. C., in spite of the decreased tensile strength obtained, is not so serious as might at first be imagined. If it be considered that the increased bending angle, and, in some cases, the increased impact value, indicate at least that the brittleness of the material is not increased, then the reduction in tensile strength obtained at these temperatures is not sufficient to outweigh the advantages obtained by the elimination of distortion.

It would also appear that the annealing of cast iron at temperatures in excess of 600 deg. C. and also in the neighbourhood of from 300 to 400 deg. C. is not to be recommended.

(To be continued.)

* Discussion on Dr. Hatfield's Paper, Aero Soc., 1917.

"Pyrotip" Heater.*

In practically every line of manufacture some means of local heating is required for various operations. The most common form is the gas flame, using illuminating gas with or without compressed air. In fine work, as in jeweller's shops, the alcohol lamp and blow torch are used. For portable work the gasoline blow torch is commonly used. For more intense heat the oxy-acetylene flame is employed, as well as the electric arc, using either carbon or metallic electrodes.

A convenient and economical method of local heating is obtained by using the Pyrotip, which is the trade name given to a low voltage transformer that has been specially designed for work of this nature. The secondary of the transformer furnishes sufficient current to quickly heat up the point of an ordinary ⅝-in. carbon rod. The voltage is so low that an arc cannot be drawn, but the temperature of the carbon point can be varied through a wide range by simply altering the amount of contact surface at the end of the carbon.

The most evident field for this device is in the melting or joining of lead parts or terminals of storage batteries. Lead, unless a clean surface is obtained, cannot be readily melted with a soldering copper. Temperature control, especially for lead burning, is accomplished by altering the depth of submersion of the carbon tip in the molten lead. That portion of the carbon which is submerged assumes a temperature but little above the melting point of lead, 326 deg. C. Just above the surface the carbon is much hotter, approaching 1,200 deg. C. when submergence is 1/16 in., and 700 deg. when immersed ½ in. The greater energy put into the lead under these conditions is dissipated without leaving a high temperature because of the greater contact surface between the carbon and the lead. It permits the lead to carry off the heat and radiate it more rapidly.

In direct soldering, the hot point of the carbon burns the tin in the solder; so successful work involves "tinning" the surfaces by other means, and then placing the hot point somewhat back from the joint and heating by conduction. The transformer can easily be used to heat soldering coppers by attaching a suitable holder to the low-tension terminals, and with advantage, since there is no danger of superheating and burning the end.

In jewellery stores a considerable amount of silver soldering is required in repairing broken silver spoons, gold rings, etc. The Pyrotip, utilising a split or forked carbon electrode, is readily used. In this same line of work they have frequent need to melt down pieces of gold, silver, or platinum. The platinum works down in relatively small quantities, and it only takes a few seconds to melt down the platinum, whereas the gas ordinarily available requires a considerable length of time. It is also a simple proposition to utilise the same combination to melt down pieces of gold or silver from watch cases, putting them in small ingot form.

In the same way dentists can utilise the device for melting down old gold fillings, bringing them back to shape so that they can be used over again.

Dark glasses are desirable in this work, although not so essential as with other forms of local heating, due to the ease with which the eyes can be protected by properly manipulating the holder.

* From an article by E. A. Wagner in the "General Electric Review," vol. 24, p. 628 (July, 1921.

Messrs. Palmer's Steel Works, Jarrow, which have been closed down since the first week of the recent coal stoppage, have been restarted.

Heat Treatment of Rock-Drill Steel.

In a Paper read by MR. A. E. PERKINS on "The Breakage and Heat Treatment of Rock-Drill Steel" at a meeting of the American Institute of Mining and Metallurgical Engineers in New York, the author, in the course of some remarks on the study of steels which give greatest service before breakage, referred to a Paper read before the British Institution of Mining Engineers, in which the conclusion was reached that as regards chemical composition carbon content was about 0.60 per cent., but that was dependent upon the character of labour that they had to depend upon to make those drills; but that is so radically different from the results in the United States and the results shown with the higher carbon steel as to be quite noticeable.

On the other hand, continued Mr. Perkins, the consensus of opinion seems to be that the higher carbon steel will withstand the vibration shocks to which it is subjected in the hammer-drill service, and that the cutting bit, although requiring more care in the tempering and working, may be made to last much longer than is possible with lower-carbon steel. The author believes that the following specifications are right for straight carbon drill-steel under the average present-day conditions:—Carbon, 0.85 to 0.90; manganese, 0.30 to 0.40; phosphorus, 0.03; sulphur, 0.03 per cent.

In buying drill steel, however, one must not rely too strongly on chemical analysis as an indication of quality, for the quality of a steel which has to be hardened and tempered depends far more upon the process of manufacture and the character of the workman than on the chemist. Tool steel of good quality was made long before chemists were heard of, and it is safe to say that steel of equally good quality can be produced to-day in small quantities without the assistance of chemists in any step of the process.

The author has no figures to present to answer the question: How long will a piece of drill steel last? There are so many variables that any such figures are bound to be individual. Such figures to be at all comparable, should be expressed in terms of drilling hours rather than in drilling footage or in pounds of steel per ton of rock broken.

Summary.—The points which make for maximum service from drill steel may be summarised as follows:—

Keep the heat down. Ninety-five per cent. of the trouble which results underground is the result of overheating in forging or in tempering or both. Preparatory to forging, never heat either the bit end or the shank end higher than 1,600 deg. Fah. This may mean a little more work by the blacksmith, but the gain in quality of the finished drills will greatly offset the slight additional expense in forging. Overheating a piece of steel preparatory to forging produces coarseness of structure which cannot be restored or refined by merely allowing it to cool and temper.

To harden successfully, plenty of time must be given to the heating, and always leave the steel in the furnace long enough to ensure its being heated uniformly and thoroughly. This may be best accomplished in a slow fire and only by slow uniform heating is it possible to secure the required uniformity in hardness.

Steels left too long in the fire, especially when not turned about, are liable to show soft spots in hardening, due to slow decarbonisation.

After hardening and tempering either bit or shank always quench at the critical temperature on the rising heat.

When tempering shanks, do not overlook the fact that density and toughness provide wear-resisting qualities, and that hardness, except on the extreme outer surface, is not essential or desirable. Subject the part for a distance of 2 in. below the lugs or collar to the heat treatment.

Either keep the heated tool moving about in the quenching bath or keep the bath agitated, otherwise soft places may result, due to the steam which is formed around a heated steel upon being plunged into water.

To get uniform results in hardening, a good supply of water should be provided so that the temperature of the bath will be kept as nearly as possible a constant.

Discourage the practice of operating with a dull bit, and remember that the only reason why steel will drill rock is because of the cushioning effect of penetration at every blow delivered. The effect of continued hammering on a dull steel is exactly the same at it would be in driving up against an impenetrable substance, such as a hardened anvil. Minute fatigue checks are established throughout the length of the drill steel. At the beginning they may be so small as to be hardly detected with the naked eye, but with continued operation one of these fatigue checks, which will develop at the weakest point, will gradually grow larger by assuming an arc-shape appearance extending into the body of the steel. As this check enlarges it is caused to open and shut at each vibration or blow of the hammer in the drill.

A breathing action is thus established which, when the gap opens, causes an inrush of air, carrying in with it impurities, part of which are retained by the surface when the mouth closes. It is these foreign particles sucked in with the air which give to the surface of the check a discoloured appearance. The smooth surfaces of the check are due to the hammering action to which they are subjected by the closing of the jaws for every blow or vibration. Eventually the steel is broken apart with the balance of the section, disclosing a good, clear fracture of the metal in its original condition.

Watch sharpening machines for worn dies and dollies. Worn parts of a sharpener often cause poor bits to get out. These bits are usually feathered badly, which means that a feather or tip of steel is left on one or more of the corners. These feathers, of course, break off as soon as they are put in the drill and cause a rapid loss of gauge.

Watch the air pressure at the sharpening machine. Most sharpeners should have at least 80 lbs. at the machine, and if the machine is running on less pressure and the smith tries to forge the bit at the proper temperature, it gets cold before he can get the corners on, so to get out his work he usually yields to the temptation of putting the steel through hotter than he should. If the pressure were high enough he could complete the forging of the bit at the proper temperature before it got too cold.

Keep the check bushing up to size, and remember that the worn end of a check bushing will prevent the transmission of a square, direct blow. This same statement will apply to the size of the drill shank.

THE USE OF FLUOR-SPAR IN THE BASIC OPEN-HEARTH FURNACE.—It is now well known that the addition of a certain quantity of fluor-spar to a good basic slag facilitates, in a marked degree, the removal of sulphur from a melt of mild steel. The use of fluor-spar for this purpose is rapidly extending in Germany. The author shows that by the addition of spar the sulphur remaining in the steel may be reduced from 0.08 to 0.05 per cent. The effect of the spar is to increase in large measure what is called the "coefficient of separation," i.e., the relation of the sulphur in the slag to that in the steel. For example, for a slag containing 0.3 per cent. S and steel from which it was derived containing 0.05 per cent S, the coefficient is $\frac{0.30}{0.05}=6$. By the addition of fluor-spar to the slag, the coefficient may be increased from 3.15 to 6.5, average values.

A consideration of the action of the spar leads to the conclusion that its addition to basic open-hearth slag causes the latter to decompose only within certain limits, which lie within 2 and 2½ per cent. of its calcic fluoride content. The slag is not made more basic by the addition of the spar. Though there is an escape of silicic acid in the form of silicic fluoride, the loss is constantly being made good. Experiments show this. Sulphur seems to escape from the slag in some volatile form, and the slag is thereby enabled to take up more from the bath. This seems to be the mode of action of the fluor-spar. The question is fully considered by the author and illustrated by curves and tabulated results of experiments.

XUM

Trade Talk.

MESSRS. PH. BONVILLAIN and E. Ronceray have transferred their office to Rue Paul Carle Prolongée, Choisy-le-Roi (Seine), France.

THE SCOTTISH TUBE COMPANY, LIMITED, of Glasgow, have now opened an office and warehouse at 44, Victoria Road, Holbeck, Leeds.

THROUGH a breakdown of the largest rolling mill at Clydesdale Iron & Steel Works, near Motherwell, from 500 to 600 men will be thrown idle for a period of several weeks.

SOME two hundred years after his death, a memorial of Thomas Newcomen, inventor of the atmospheric steam-engine, has recently been erected at his birth place, Dartmouth.

A company called the British Trade Ship, Limited, has been formed, with registered offices at 12, Grosvenor Gardens, S.W.1, and a board assembled under the chairmanship of Earl Grey.

THE statement that Lord Pirrie has acquired the control of Messrs. Workman, Clark & Company's Belfast shipyards from the Northumberland Shipbuilding Company, Limited, is officially denied.

IT is reported in Newcastle that the Elswick firm of Sir W. G. Armstrong, Whitworth & Company have received an important order from the British Government. The contract is stated to run into several millions of pounds.

THE Electricity Commissioners have sanctioned the borrowing by the Keighley Corporation of £27,374 for electricity purposes. This is only part of the amount applied for, the balance, £26,252, being held over for further information.

AN interesting meeting of the members of Vickers' No. 2 Branch of the Iron and Steel Trades Confederation was held in Sheffield recently. The object of the meeting was to present Mr. Cyril Hudson with the society's accident benefit of £150.

To mark the recent centenary of James Watt, the Institution of Shipbuilders and Engineers have founded two new chairs in Glasgow University—a James Watt Chair of Electrical Engineering and a James Watt Chair of the Theory and Practice of Heat.

SINCE the announcement of the price reduction in Karrier chassis a considerable increase in the number of orders have been received at the Huddersfield works, and it is interesting to note that many of these have come from Ireland, where trading conditions seem to have improved since the alteration in the political situation.

WE ARE advised that the Lyttelton Harbour Board of New Zealand have accepted a tender from the Wellman Smith Owen Engineering Corporation, Limited, London and Darlaston, for two 5-ton level luffing cranes (Jardine Patent) this being a repeat order of four similar cranes ordered from the same firm early this year.

THE new French coins which are to take the place of the 2 franc, 1 franc, and 50c. notes now in circulation are struck from an alloy of bronze-aluminium, the proportions of which have only been found after much research. The present small output of ten million francs per month is due to the deteriorating effect of the alloy on the coining machinery.

THOUGH only one vessel has been launched on the River Wear during the month of August, following a blank month in July, there is stated to be slight signs of a revival in the Sunderland district shipbuilding industry. The launch during August was the "British Chancellor," built by Messrs. Sir James Laing & Sons, Limited, a vessel of 7,300 tons tonnage.

THE mechanical staff of the North-Eastern Railway Company is pardonably proud of the Darlington-built world's record-breaking freight locomotive, No. 903 One of five of the most powerful type of goods engine the company possesses, she emerged triumphant from an important and severe test made near Perth. The engine is of the three-cylinder type, built more for power than speed.

AT A monthly meeting of the Newcastle and District Foremen Engineers and Chief Draughtsmen's Association, held on September 3, under the chairmanship of Mr. J. G. Brewster, of Newcastle, reports were presented by Messrs. C. Johnson and T. Gibson, of Newcastle, relative to their visit to Leeds and Keighley respectively. Arrangements for the Association's celebration dinner in Newcastle, on September 24, when the chair is to be taken by Earl Grey, of Howick, were completed

THE ROYAL METAL TRADES' PENSION SOCIETY'S fifth annual whist drive will be held at the Portman Rooms, 59, Baker Street, W.1, on Thursday, November 3. There are many of the aged pensioners of this Society who have practically nothing to live upon except the Old Age Pension and the allowance the Society has granted them. The committee are, therefore, endeavouring to raise a sufficient sum to permit of an extra allowance to those pensioners during the forthcoming festive season. Tickets can be obtained from the secretary, at 195, Upper Thames Street, E.C.4.

ON Monday, September 5, Sir Raylton Dixon & Company, Limited, launched from their Cleveland Dockyard, Middlesbrough, the steamer "P.L.M. 24," the fifth of eight similar vessels which they are constructing for La Compagnie des Chemins de Fer de Paris à Lyon et à la Mediterranee. Her principal dimensions are 400 x 56 x 31, moulded with a deadweight carrying capacity of about 8,900 tons on a light draught of water.

J. BLAKEBOROUGH & SONS, LIMITED, Woodhouse Works, Brighouse, Yorks, have secured the contract for the supply of valves in connection with the Tansa completion project for the Bombay Municipality. The pipe line, the contract for which we understand has been secured by Messrs. Braithwaite & Company, Calcutta, is approximately 105 miles long, and Messrs. Blakeborough's portion of the contract works out at approximately £23,000.

THE Derbyshire iron trade depends to a large extent upon the pipe foundries which are specially equipped for the production of all classes of cast-iron pipes for water, gas and oil. Recently trade has fallen off because foreign pipes are being offered in this country at a lower price than the cost of manufacture in Derbyshire, and consequently the Staveley Coal & Iron Company have given notices to about a hundred men employed in the pipe shops.

ARTICLES included in any of the lists and articles falling under any of the following genera' descriptions will, subject to the provisions of the Safeguarding of Industries Act, 1921, be chargeable with duty under Part 1 of the Act on October 1 next: Lamp-blown ware; wireless valves and similar rectifiers, and vacuum tubes; ignition magnetos and permanent magnets; arc-lamp carbons; hosiery latch needles; metallic tungsten, ferro-tungsten and manufactured products of metallic tungsten.

THE ACTION of the Mersey Ship Repairers' Federation in giving notice of the withdrawal, as from Monday, of the restrictions imposed by the boilermakers in regard to the use of the oxy-acetylene burner, resulted in the men engaged on this work declining, on the advice of their union, to handle the burner. An employer stated that, with the trade of the port at such a low ebb, it was impossible to continue a system which entitled squads of men to receive wages for merely watching others work.

INTERESTING matters were under discussion at the Divisional Conference of the Iron and Steel Trades Confederation held at Neath on Saturday last. Mr. J. Hughes, Llanelly, who presided, alluded to the troublous times the trade had experienced, but expressed the opinion that the clouds were lifting, and that the outlook was more hopeful than for many months. With his colleagues, he viewed with satisfaction the application and prospective amalgamation of the Tin and Sheet Mill Men's Association with the confederation.

WE understand that provisional arrangements have been made for a union between the firms of Fairbairn, Lawson, Combe, Barbour, Limited (Leeds, Belfast and Lille), Urquhart, Lindsay & Company, Limited (Dundee), and Robertson & Orchar, Limited (Dundee). It will be remembered that Fairbairn, Lawson, Combe, Barbour, Limited, was incorporated in 1900 as a combination of the firms of Fairbairn, Naylor, Macpherson & Company, Limited, Wellington Foundry, Leeds; Samuel Lawson & Sons, Hope Foundry, Leeds; and Combe, Barbour & Combe, Limited, Falls Foundry, Belfast.

THE BOARD OF ARBITRATION set up for the settlement of the dispute between the Shipbuilding Employers' Federation and the various shipbuilding trade unions concluded its sittings in Newcastle on September 1. The court consisted of Sir William MacKenzie, K.C., K.B.E. chairman, Mr. James Fullerton, nominated by the employers, and Councillor G. T. Rowe, nominated by the workers, with Mr. A. Gunn as secretary to the Board. The case of the boilermakers was concluded, as also was that of the ship constructors and shipwrights and the associated blacksmiths and ironworkers. The award will be issued in due course.

HARLAND & WOLFF, LIMITED, of Belfast, are, as mentioned some time ago, establishing ship-repairing and engineering shops on the Thames. A start will be made with the repair work at various places on September 15. According to the annual report of the Port of London Authority, certain proposals were made by Harland & Wolff, Limited, for the granting of facilities to enable them to establish in the Port of London extensive ship-repairing and other engineering workshops. The proposals involved the granting of leases to the company of sites on the Authority's property in the docks and on the riverside, the taking over of the Authority's existing shops with some of the staff, and the execution by the company on cost and percentage terms of such repair and constructional work as may be required by the Authority.

Applications for Patents.

Anderson, J. S., and Miller R. Percussive rock-drills, etc. 20,421. July 29.
Babcock & Wilcox, Limited. Centrifugal induced-draught, etc., fans. 20,259. July 28.
Cammen, L. Casting metal tubing. 20,400. July 29. (United States, January 24.)
Cromwell Engineering Company, Limited, and Ewbank, W. A. Universal tool and cutter grinder applicable also for surface works. 20,457. July 30.
Danby, H. C. Automatic grab for steel ingots, etc. 19,934. July 25.
English, W. E. Steam-superheaters. 20,197. July 27.
Girouard, Sir E. P. C. Reduction or preparation of ores. 20,080. July 26.
Goodman Manufacturing Company. Mining-machines. 19,938. July 25.
Greiner, F. Processes for melting iron containing high percentage of silicon. 20,320. July 28.
Greiner, F. Process for manufacture of alloys of iron. 20,321. July 28.
Kestner, P. Centrifugal Pumps. 20,157. July 27. (Belgium, April 25.)
Ransome & Company, Limited, A. Device for holding and driving revolving drills, reamers, etc. 19,995. July 25.
McFarlane, J. Screw-cutting die. August 5. 20,811.
Metropolitan-Vickers Electrical Company, Limited. Governing-means for steam-turbines. August 4. (United States, September 4, 1920.) 20,779.
Moore, W. E. Power-transmission mechanisms. August 5. 20,850.
Tyson, E. H. Blowpipes for foundry, etc., uses. August 4. 20,723.
Babcock & Wilcox, Limited (*Babcock & Wilcox Company*). Steam-superheaters. 21,223. August 10.
Ball, E. B. Moulds for centrifugal casting-machines 21,253. August 10.
Bowness, E., Ewen, J. A., and Slater, C. H. Moulds for die or pressure casting or centrifugal casting. 21,027. August 8.
Bowness, E., Ewen, J. A., and Slater, C. H. Moulds for casting metals. 21,028. August 8.
Bowness, E., Ewen, J. A., and Slater, C. H. Die or pressure casting. 21,030. August 8.
Bowness, E., Ewen, J. A., and Slater, C. H. Apparatus for making moulds for casting. 21,245. August 10.
Bowness, E., Ewen, J. A., and Slater, C. H. Making moulds for casting. 21,246. 21,247. August 10.
Cammen, L. Casting metal tubing. 21,009. August 8.
Hudson, T., and Lambert, W. E. Steam-generating plants. 21,429. August 12.
Moore, A. A. Detachable adjustable lathe centre. 21,304. August 11.
Moore, M. S. Coal-cutting, etc., machines. 21,569. August 13.
Oil Well Engineering Co., Ltd. Friction clutches and brakes. 21,032. August 8.
Pearn, W. A. Machine tools. 21,362. August 11.
Sturtevant Company, B. F. Fuel-feeding mechanism for underfeed stokers. 21,299. August 10.
Weymerskirch, T. Iron moulds for casting rolls for rolling-mills. 21,378. August 11.
Allan, F. Bolts, rivets, etc. 21,590. August 15.
Bechler, A. Automatic screw-cutting lathe. 21,863. August 17. (Switzerland August 17, 1920.)
B.S.A. Tools Ltd., and Ogilvie, W. Drill heads for drilling-machines. 22,125. August 20.
Cheltnam, C. H. W. Centrifugal fans and pumps. 21,932. August 18.
Haston, W. Drills for stone, coal, etc. 22,017. August 15.

Production of Pig-iron and Steel in August.

The production of pig-iron in August amounted to 93,600 tons, compared with 10,200 tons in July. The output in March, the month immediately preceding the coal stoppage, was 386,000 tons, and in August of last year 752,400 tons, which was the record monthly total since the war.

The production of steel ingots and castings in August amounted to 432,600 tons, compared with 117,200 tons in July, 359,100 tons in March, and 709,200 tons in August, 1920.

The number of blast furnaces in operation at the end of August was 46, as against 15 at the end of July. The number in operation immediately before the coal stoppage was 109, and in August of last year 303.

Of the pig-iron produced in August 30,200 tons were hematite, 24,400 tons basic, 28,500 tons foundry, 8,500 tons forge, and 2,000 tons of "other qualities."

Gazette.

THE PROVINCIAL METAL COMPANY, LIMITED.—It was resolved August 16:—That the company be wound up. Mr. J. D. Kerr, 5, Waterloo Street, Birmingham, has been appointed liquidator.

THE PRECISION TOOL CO. (HALIFAX), LIMITED.—It was resolved August 26:—That the company be wound up voluntarily. Mr. E. Bairstow, District Bank Chambers, Halifax, C.A., has been appointed liquidator.

THE LAST DAY for receiving proofs in connection with a dividend to be paid by Mr. S. H. Dougherty, carrying on business at 106, Kensington, Liverpool, and lately at 36, Renshaw Street, Liverpool, as the Mersey Electric Company, is September 21.

MR. W. J. D. PARSONS, Guildhall Buildings, Navigation Street, Birmingham, and 23, Dale Street, Leamington, mechanical engineer and machinery merchant, has been adjudicated bankrupt. Examination, County Court, Birmingham, October 5, at 2.30 p.m.

THE MAPLESTONE CANTILEVER SPRING FORKS, LIMITED.—A petition has been presented by Birmingham Products, Limited, for the winding up of the company's affairs. Hearing, County Court, Birmingham, September 15, at 11.55. Messrs. G. T. Smith, Lyde & Parkhouse, 24, Bennett's Hill, Birmingham, solicitors.

THE partnership heretofore subsisting between Messrs. R. McNeil Crawford, A. R. Bone, G. W. Bone, J. H. Flitton, and A. Pratt, ironfounders, Icknield Road, Leagrave, Bedford, under the style of the Alliance Foundry Company, has been dissolved. The business will be carried on in future by Messrs, A. R. Bone, G. W. Bone, J. H Flitton and A. Pratt.

Company News.

Wallsend Slipway & Engineering Company, Limited.—Interim dividend, 6¼ per cent.

Davis & Timmins, Limited.—Interim ordinary dividend, 6 per cent. per annum (free of tax).

Cammell, Laird & Company, Limited. — Interim dividend, 2½ per cent., less tax, on 5 per cent. cumulative preference shares; no interim ordinary dividend.

Palmers Shipbuilding & Iron Company, Limited.—Final preference dividend, 2½ per cent., less tax; interim ordinary dividend already paid is final for year.

Ibbotson Brothers & Company, Limited. — Profit, £28,434; brought forward, £54,290; available surplus, £68,309; final dividend, 6s. per share, making 10 per cent., tax free, for year; carried forward, £61,304.

Guest, Keen & Nettlefolds, Limited. — Profit, £810,102; brought forward, £261,604; available balance, £1,071,706; interim dividends, first and second preference, 5 per cent. per annum, and ordinary 10 per cent. per annum, all free of tax; £398,874, final dividends, first and second preference, 5 per cent. per annum, free of tax, £150,391; final ordinary dividend, 10 per cent. per annum, free of tax (making 10 per cent., free of tax for year), £258,345; carry forward, £264,098.

Personal.

THE LATE MR. C. CAMPBELL, retired brassfounder, Dumbarton, left £6,285.

THE LATE COLONEL JAMES SMITH PARK, of Glasgow, a director of Wm. Beardmore & Company, Limited, has left estate valued at over half-a-million pounds.

THE LATE SIR THOS. WRIGHTSON, BART., chairman of Head, Wrightson & Company, Limited, and a director of the Cramlington Coal Company, Limited, the North-Eastern Steel Company, Limited, and other companies, left gross estate of the value of £212,074, with net personalty £91,881.

SIR WM. BUTLIN'S research work in connection with the development of the iron trade of this country is the subject of an interesting article in the current issue of the "Whitehall Gazette." After touching on the early history of the Iron Age, the writer briefly summarises the developments in iron manufacture until the year 1851, when Sir Wm. Butlin's father, William Butlin, recognised the possibilities in the manufacture of iron from Northamptonshire ores. The furnaces were accordingly built at East End, Wellingborough, in 1852, and the enterprise proved so highly successful that in 1866 the works were transferred to a larger site adjoining the Midland Railway, where, as "Thos. Butlin & Company, Limited, Irthlingborough Iron Works, Wellingborough," the firm became known throughout the world. Sir Wm. Butlin was for over 24 years chairman and managing director of the firm, and only retired in August, 1920, when the business was amalgamated with that of the United Steel Companies, Limited. Accompanying the article is an excellent coloured sketch of Sir Wm. Butlin.

XUM

IRON AND STEEL MARKETS.

Pig-iron.

Movements towards more active conditions in the pig-iron industry have made but little progress since last reported, and any hopes that were entertained of any early substantial revival of trade appear likely to meet with disappointment. Market operations, as far as buying in any quantities of importance are involved, are apparently held in abeyance by the prevailing conviction that an era of lower prices is imminent, but regarded from the standpoint of present productive costs, any serious reduction in selling values of pig is extremely unlikely to materialise in the near future. The position as it now stands may best be summarised in the fact that prices are still too high to stimulate home demand, or to enable producers to compete successfully abroad. Some encouragement may, however, be derived from reports of Continental movements in pig-iron prices, where the tendency of markets is distinctly towards an advance in quotations, bringing Belgian and French values a shade nearer to a competitive basis with the home products. In the Tees-side area a gradual increase in the number of furnaces in operation is a satisfactory feature, the total now in blast amounting to fifteen, while during the next few weeks several other plants are expected to be re-lighted. But the current demand for foundry iron is by no means brisk, and at present only two furnaces are turning out this particular quality. Some of the foundries engaged on rough castings are, however, fairly busy, but the quiet conditions in the shipbuilding industry have had a depressing effect upon the firms employed in marine work of this description. There is still a little No. 3 Cleveland G.M.B. to be had, but consumers are reluctant to pay 135s. per ton, and only buy to cover their minimum needs. No. 4 foundry is more plentiful, but here, again, 125s. is regarded as too dear, and makers find great difficulty in disposing of any of the lower qualities, which, however, are kept firmly at the recent minimum figures, namely, 117s. 6d. for No. 4 forge and mottled, and 115s. for white iron. In the Manchester market there is not much demand now for No. 3 foundry pig, and the reason no doubt is that founders are short of orders. Basic pig-iron needs to be made more cheaply or there is a danger that steel works will keep their furnaces idle and work on foreign pig-iron. In South Staffordshire, as far as general demand for pig-iron is concerned, the market is as unsatisfactory as ever. The foundry trades, both heavy and light, are depressed, and with very trifling exceptions the finished iron industry is at a standstill, so that the call for both foundry and forge irons is extremely poor, more so than it has been for a generation. The difficulty is still largely, if not entirely, one of prices. As far as pig-iron is concerned, smelters themselves do not see that the outlook for fuel is yet so assured that they can confidently prepare for the blowing in of their furnaces.

On Tees-side even with the increased production of hematite there is not a great quantity available at the moment, as stocks had been pretty well depleted. Makers are, however, quite ready to accept forward contracts at 140s. for East Coast mixed numbers and 142s. 6d. for No. 1. There is, however, no pressing demand at home, and foreign buyers regard the price as still too high. In West Cumberland and North Lancashire three furnaces at Millom, North Lonsdale and Cleator Moor are smelting low-phosphorus iron, and the United Steel Companies at Moss Bay, at Workington, are turning out ordinary iron. Meanwhile a recent reduction in the price of Bessemer mixed numbers has been made, the present quotation being £7 per ton f.o.t., or £7 15s. per ton delivered Sheffield.

Finished Iron.

No change of importance can be recorded in the finished iron trade in South Staffordshire, and although mills engaged on marked bars are still employed to a fairly satisfactory extent, there is practically little or nothing stirring in crown and the commoner qualities of this material. There is, of course, a limited tonnage of the latter turned out, but its total weight is quite unimportant compared with the productive capacity of the district. Unless under very exceptional circumstances there are no buyers of crown bars at £16, and makers themselves recognise the difficulty of doing business at the price; but, they state, they are unable to offer concessions until costs are much more reasonable and in proportion to the requirements and capacity of the industry. In the meantime rolled iron is being largely displaced by imported steel. Gas strip can be written down as unsaleable at £20, and though makers fully recognise this, they state that they cannot see what useful purpose a reduction would serve in stimulating business. Demand on behalf of the Black Country nut and bolt and fencing trades is meagre. Iron at £16 a ton is too dear to be used for fencing purposes, and wire is substituted. The nut and bolt works are having a slack time. Not only is trade stagnant, but it is understood that Belgian nuts and bolts can be purchased round about the price asked for the locally made bars. The South Yorkshire Bar Iron Association met last week, but it is understood that no change was made in the basis price of "Crown" bars, which thus remain at £15 net, though whatever business is done is usually in "best" at 20s. more. Foreign iron and steel continues to come into the district at cut rates. The imports of iron, steel, etc., at Hull from abroad during the week past were:—Iron, pig, 984 tons (Bleasdale & Company), 50 tons (Wilson's & N.E.R. Company), 50 tons (Hull & Sheffield Transport Company); bar, 12 tons (Wilsons' & N.E.R. Company), 50 tons (H. Ferguson & Company). Steel: 1,223 tons (Bleasdale & Company), 87 tons (Furley & Company). Zinc sheets, 3 tons (Hull & Netherlands S.S. Company). 2 tons (Wilson's and N.E.R. Company). Grimsby: Iron, pig, 100 tons, steel 99, bars 1,781 blooms (order). Goole: Iron, pig, 320 tons, 8,847 bars, 1,378 plates; steel, 661 plates, 504 rails, 250 billets, 673 joists (order).

Steel.

The approaching end of the third quarter of the year marks a gratifying, if only partial, return to revived activity in the steel industry, which, it is hopefully anticipated, may indicate a turn in the tide of depression so long experienced in the trade. There is, for example, a more hopeful feeling in Scottish steel trade circles. It is not founded, however, on anything tangible in the form of an improvement in industrial conditions, but on the gradual decline in home prices, from which much is expected when the existing gap between quotations for British and Continental materials has been eliminated or greatly reduced. The process of deflation of prices is dependent, of course, upon the costs of production, and as these are not falling as quickly as might be hoped, drastic cuts are impossible. On the North-Eastern Coast, notwithstanding the prolonged depression, the great firms engaged in the steel industry are financially stronger and sounder than at any previous period in the history of the trade. They are better organised for world business than ever before, and the relationship which obtains between employers and employed is the envy of many other industries. In the Sheffield area also, although conditions in the various branches of steel manufacture continue patchy, it is satisfactory to learn that work is being gradually resumed, if on a limited scale at present, some substantial consignments of special steels having been shipped to the United States, probably in anticipation of the threatened heavy tariff shortly to come into force. Some fairly good orders for railway tyres for South Africa are also reported to have been placed with Sheffield firms, while saw makers are said to be having a busy time just now. There is a better demand also for bright-drawn steel bars, and case-hardened material suggesting renewed activity in the output of textile machinery, automobile, electric tramway and agricultural appliances, while electrical engineering and the cutlery branches are doing fairly well in their respective departments. Although recent reports of the crucible steel branch have been by no means encouraging, it is reassuring to learn that one firm in Sheffield are busy, Messrs. Henry Rossell & Company, Limited, of the Ivanhoe Works, operating their furnaces 24 hours the day, with ample orders both for home and overseas consumers. Price movements in the steel trade are at present without noteworthy change, but unquestionably the recent reductions in wages, and some forms of raw material and fuel, must have an ultimate effect in lowering values to an appreciable extent, and will enable producers to meet foreign competition on more favourable terms. Hoops have been reduced £3 5s.

Scrap.

Reports from the various centres of the scrap trade indicate generally some revival of inquiries, but on the whole very little actual business is passing. At Cleveland, sales of steel scrap are at a minimum in consequence of the continued inactivity at the steelworks, and the demand for cast iron is affected by the slackness in the foundries. Prices are nominal at around the following delivered figures:—Heavy steel scrap, £2 15s. to £3; heavy cast-iron machining scrap, £5 15s.; heavy wrought-iron, £3 10s.; c.i. borings, £1 15s.; steel turnings, £2 5s. There is certainly a much brighter tone prevailing in the Midland scrap markets, heavy steel scrap and turnings being inquired for fairly freely, and there is more firmness regarding wrought iron than has been the case for some time.

Ore.

In the Cleveland district, corresponding with conditions in the pig-iron trade, the market for foreign ore continues quiet, but it is significant of the trend of the market that there is more disposition to discuss business on future account. Even actual transactions have been reported involving dealing on the basis of 28s. 6d. per ton for best Bilbao rubio, c.i.f. Tees, while later the quotations has marked 29s. It may also be of interest to our readers that at the recent meeting of the Iron and Steel Institute in Paris, in the discussion following a Paper read by M. Nicou on "Iron Ore Deposits of Eastern and Western France," Professor Louis, of Newcastle-upon-Tyne, said he contested one statement in the Paper regarding Great Britain's dependence on foreign ore. There were, he said, 3,400 million tons of ore available in Great Britain, and much of it was not utilised because foreign ore was cheaper.

Tinplates.

Although some improvement can be recognised in the number of mills employed in South Wales, now amounting to about 35 per cent., the conditions generally in the tinplate trade still leave much to be desired before a return to normal activity can be realised. There has, however, been a little more inquiry during the past week, but whether any business of importance results remains problematical. Spot plates are in fair demand; 23s. 6d. basis is generally quoted for September, but 23s. is reported as having been taken. For October, onwards, 21s. is the nominal figure. Wasters are in moderate request. CW. 28 by 20 at round 39s. per box; CW. 14 by 20 at 19s. 6d.; and CW. 14 by 18¾ at 16s. to 16s. 3d.; all net cash, f.o.t., at works. Terneplates are in poor demand, 22s. is the price usually quoted for approved specifications, net, f.o.t.

Metals.

Copper. — Developments in the standard copper market of late have been considerably restrained by a sluggish consumptive demand, which has restricted sales to a disappointing extent, and though values have remained fairly firm, the volume of business has been unimportant. The sharp set-back experienced a week ago in forward delivery metal was discouraging to operators for this position, three months' selling in this week's opening market at £68 15s. to £68 2s. 6d., with intermediate dates neglected. Refined descriptions ruled easier with electrolytic 10s. lower at £71 10s., and wire bars unchanged to 20s. lower at £72 10s. to £73. Closing prices:—Cash, Wednesday, £68 12s. 6d.; Thursday, £67 5s.; Friday, £67 2s. 6d.; Monday, £67 5s.; Tuesday, £67 17s. 6d. Three Months: Wednesday, £69 12s. 6d.; Thursday, £68 5s.; Friday, £68 2s. 6d.; Monday, £68 5s.; Tuesday, £68 17s. 6d.

Tin. — The unexpected strength of the statistical position has, so far, had little effect upon the tin market, which opened this week with an easier tendency, Eastern advices giving buyers at £156 10s., c.i.f., though holders declined dealings at that figure. Consumptive demand in this country has continued quiet, but the Continent has been taking moderate quantities. As regards the Straits, they have been selling freely at around the London parity, and seem eager to dispose of their metal. Batavia has also been selling recently although at full prices. Initial movements in three months' delivery showed a decline of 40s. from Friday's quotation, but with sellers reserved and a quiet covering demand prices gradually improved towards the close. October was done at £156 15s.; November, £157 5s. to £158, closing at £157 10s.; December, £157 15s. to £158. For c.i.f. New York, £158 10s. to £159 was paid. English ingots nominal at £154 to £155. The weekly return of tin stocks in London warehouses shows an increase of 19 tons at 3,874, with the stock in Liverpool 57 tons smaller at 1,690 tons. Closing prices:—Cash: Wednesday, £161 17s. 6d.; Thursday, £159; Friday, £156 5s.; Monday, £156; Tuesday, £156 12s. 6d. Three Months: Wednesday, £164 10s.; Thursday, £161 10s.; Friday, £156 10s.; Monday, £158 5s.; Tuesday, £158 15s.

Spelter.—The market for this metal remains quiet and featureless, and although more activity is reported in the galvanising trade, business, on the whole, is on a limited scale. That restricted consumptive demand for spelter is fairly general is emphasised in the figures published by the United States Geological Survey. The production of zinc from domestic ores during the first six months of the current year amounted to 100,761 short tons, and from foreign ores, 1,744 tons, making a total of 102,525 tons, which compares with 258,018 tons during the corresponding period of last year and 205,269 tons during the latter half of that year. Closing prices: — Wednesday, £25 7s. 6d.; Thursday, £25 10s.; Friday, £25 10s.; Monday, £25; Tuesday, £25 5s.

Lead.—In Monday's market for this metal sellers of soft, foreign pig were reserved, and with a quiet demand quotations for near dates were advanced 5s., with forward 2s. 6d. higher. September was done at £23 10s. to £23 12s. 6d., and October at £23, English lead was firm and fractionally improved. Closing prices:—Wednesday, £24 5s.; Thursday, £24 5s.; Friday, £24 5s.; Monday, £24 10s.; Tuesday, £24 15s.

MR. J. P. ROE, of Thyra Grove, Finchley, Hampstead, N.W., who was a son of the late Mr. J. P. Roe, C.E., of Consett, Durham, has died at the age of 69. The deceased gentleman commenced his career in his father's works at Cardiff. In 1870 he went to the Dowlais Iron Company, and in 1889 commenced practice as a consulting engineer at Cardiff, and undertook contracts for transporting minerals by means of aerial ropeways in the Bilbao district. Some of his most important ropeway engineering work included the Dorada ropeway, which is by far the longest in the world, viz., 47 miles.

BRITISH INDUSTRIES FAIR

BIRMINGHAM

FEB 27TH TO MARCH 10TH 1922

(Under the auspices of H.M. Board of Trade.)

A NATIONAL EFFORT
for
BRITISH TRADE.

Display your Products
in the
WORKSHOP of the WORLD,
BIRMINGHAM.

Schedule of Exhibits:—

Brassfoundry	Agriculture
Hardware	Mining
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Metals	Motor-cycles
Construction	Cycles
Building	Perambulators
Decoration	Guns
Power	Saddlery
Lighting	Harness
Heating	Fishing Tackle
Cooking	Brewing
Ventilating	Distilling
Engineering & Foundry	Catering Plant

Full particulars from

GENERAL MANAGER,

95, NEW STREET, BIRMINGHAM.

The "GEM" Mould Drying Lamp.

For Paraffin Only.

Can be supplied with larger Burner for Cupola Lighting.

Woodward Bros. & Copelin, Ltd.
Unwin Rd., Peckham, London, S.E.

WEEKLY PRICE CURRENT.

COPPER.

	£	s.	d
Standard cash	67	17	6
Three months	68	17	6
Electrolytic	72	0	0
Tough	69	0	0
Best selected	69	10	0
Sheets	103	0	0
India	103	0	0
Wire bars	74	0	0
Do. Sept.	72	15	0
Do. Oct.	72	15	0
Ingot bars	72	5	0
H.C. wire rods	81	10	0
Off. aver. cash, Aug. 68	12	8 5/32	
Do. 3 mths., Aug. 69	2	1 19/21	
Do. Settlement Au. 68	11	11 3/21	
Do. Electro, Aug. 73	10	0	
Do. B.S., Aug. 69	13	10 3/4	
Aver. spot, copper, Aug. 68	11	9 1/4	
Do. Electro, Aug. 74	5	11	
Solid drawn tubes		14 1/2 d.	
Brazed tubes		14 1/2 d.	
Wire		11d.	
Yellow metal rods		7 1/4 d.	
Do. 4x4 Squares		9 1/2 d.	
Do. 4x3 Sheets		9 1/2 d	

BRASS.

Solid drawn tubes	12 1/2 d.
Brazed tubes	15 1/2 d
Rods	11 1/2 d.
Sheets to 10 w.g.	11 1/2 d.
Wire	11 1/2 d.
Rolled metal	10 1/2 d.

TIN.

	£	s.	d
Standard cash	156	12	6
Three Months	158	15	0
English	155	10	0
Bars	157	10	0
Chinese	152	5	0
Straits	157	10	0
Australian	157	15	0
Eastern	158	10	0
Banca	158	10	0
Off. aver., cash Aug. 155	8	4 5/32	
Do. 3 mths., Aug. 157	3	5 13/32	
Do. Sttlment. Aug. 155	6	4 1/21	
Aver. spot, Aug. 155	6	9 1/4	

SPELTER.

	£	s.	d
Ordinary	25	5	0
Remelted	21	10	0
Hard	15	10	0
Electro 99.9	32	10	0
English	31	0	0
India	19	10	0
Prime Western	25	17	6
Zinc dust	45	0	0
Zinc ashes	5	0	0
Off. aver., Aug.	25	8 0 3/21	
Aver., spot, Aug.	25	1	7

LEAD.

	£	s.	d
Soft foreign ppt	23	15	0
English	24	5	0
Off. average, Aug.	23	5 1 4/21	
Average spot, Aug.	23	9	9 1/2

ZINC SHEETS.

	£	s.	d
Zinc sheets, spot	35	0	0
Do. V.M. ex. whf	36	0	0
Do. ppt., f.o.b., N.Y.			—
Dutch	34	10	0
Boiler plates	32	10	0
Battery plates	32	0	0

ANTIMONY.

	£	s.	d
English regulus	37	0	0
Special brands	42	0	0
Chinese	24	10	0
Crude	17	10	0

QUICKSILVER.

	£	s.	d
Quicksilver	10	10	0

FERRO-ALLOYS AND STEEL-MAKING METALS.

	£	s.	d
Ferro-silicon—			
45/50%	13	10	0
75%	22	0	0
Ferro-vanadium— 35/40%	22/- lb. va.		
Ferro-molybdenum— 70/80%	6/- lb. mo.		
Ferro-titanium— 23/25%, carbonless	1/6 lb.		
Ferro-phosphorus, 20/23%	£28		
Ferro-tungsten— 80/85%, carbon free	1/6 lb.		
Tungsten metal powder— 98/99%	1/10 lb.		
Ferro-chrome—			
4/6% car.	£31		
6/8% car.	£30		
8/10% car.	£30		
Ferro-chrome—			
Max. 2% car.	£78		
Max. 1% car.	£93		
Max. 0.75% car.	£110		
65/75%, carbonless	2/8 lb.		
Nickel—99·8%, cubes or pellets	£190		
Cobalt metal—97%	15/- lb.		
Aluminium—98/99%	£115		
Metallic Chromium— 98/99%	5/6 lb.		
Ferro-manganese—			
76/80%, loose	£18		
76/80%, packed	£19		
76/80%, export	£14 10s.		
Metallic manganese— 98/99%, carbonless	2/9 lb.		

Per ton unless otherwise stated.

HIGH-SPEED TOOL STEEL.

	s.	d.
Finished bars, 14% tungsten	3	0
Finished bars, 18% tungsten	3	9

Per lb. net, d/d buyers' works.

Extras—

Rounds and squares 3 in. to 8 in. inclusive 4d. lb.
Rounds and squares under ½ in. to ¼ in. 3d. lb.
Flats under 1 in. by ½ in. to ¼ in. by ¼ in., and all sizes over four times in width over thickness .. .. 3d. lb.
Bevels of approved sizes and sections .. 6d. lb.
If in coils .. .. 3d. lb.
Packing .. ..5s. cwt
Bars cut to length 10% extra

Scrap from high-speed tool steel—

Scrap pieces	5d.	
Turnings and swarf	2d.	

Per lb. net, d/d steel makers' works.

SCRAP.

South Wales—£	s.	d.	£	s.	d.
Heavy Steel			3	10	0
Bundled steel & shearings			2	10	0
Mixed iron & steel	1	0 0	3	10	0
Heavy cast iron			4	10	0
Good machinery for foundries			6	0	0
Cleveland—					
Heavy steel			2	17	6
Steel turnings			2	5	0
Cast-iron borings			1	15	0
Heavy wrought iron piling			3	10	0
Bundling scrap			3	10	0
Cast-iron scrap			5	15	0
Lancashire—					
Cast iron scrap			6	5	0
Heavy wrought			3	0	0
Steel turnings			2	5	0

London—	£	s.	d.
Copper (clean)	50	0	0
Brass (clean)	26	0	0
Lead (less usual draft)	18	0	0
Tea lead	16	0	0
Zinc	12	0	0
New aluminium cuttings	50	0	0
Brazier copper	40	0	0
Gun metal	40	0	0
Hollow pewter	115	0	0
Shaped black pewter	65	0	0

PIG-IRON.

(Premiums required for foundry).

N. E. Coast—	
Foundry No. 1	—
Foundry No. 3	135/-
Forge No. 4	117/6
Mottled	115/-
Hematite No. 1	142/6
Hematite M/Nos.	140/-
Midlands—	
Staffs. common	145/-
„ part-mine forge	160/-
„ „ foundry	180/-
„ Cold blast	—
„ basic	—
Northants forge	130/-
„ foundry No. 3	150/-
„ basic	—
Derbyshire forge	130/–to 140/-
„ foundry No. 3	150/-
„ basic	—
Scotland—	
Foundry No. 1	167/6
„ No. 3	162/6
Hematite M/Nos.	160/-
Sheffield (d/d district)—	
Derby forge	—
„ foundry No. 3	—
„ basic	—
Lincs. forge	—
„ foundry No. 3	—
„ basic	—
E.C. hematite	—
W.C. hematite	155/-

All d/d in the district.

Lancashire (d/d eq. Man.)—	
Derby forge	—
„ foundry No. 3	155/-
Northants foundry No. 3	—
Cleveland foundry No. 3	—
Staffs. foundry No. 3	—
Lincs. forge	—
„ foundry No. 3	—
Summerlee foundry	—
Glengarnock foundry	—
Gartsherrie foundry	—
Monkland foundry	—

FINISHED IRON & STEEL.

Iron—	£	s.	d.
Bars (crown)	16	0	0
Angles	16	10	0
Tees to 3 united ins.	17	0	0
Nut and bolt	16	0	0
Hoops	20	5	0
Marked bars (Staffs.)	20	0	0
Gas strip	20	0	0
Bolts and nuts, ¾ in. × 4 in.	29	0	0
Steel—			
Ship plates	14	0	0
Boiler plates	20	0	0
Chequer plates	14	10	0
Angles	13	10	0
Tees	14	10	0
Channels	13	15	0
Joists	13	10	0
Rounds, ½ in.–3-in.	12	0	0
Rounds, 3 in.–5½ in.	11	10	0
Flats, 5 in.–8 in.	13	0	0
Flats over 8 in.	13	0	0
Rails, heavy	14	0	0
Fishplates	19	0	0
Hoops	14	0	0
Black sheets, 24 g.	16	0	0
Galv. cor. sheets, 24 g.	20	10	0
Galv. fencing wire, 8 g. plain	17	10	0
Rivets, ¾ in. dia	22	0	0
Billets, soft	7	10	0
Billets, hard	8	10	0
Sheet and tin bars	8	10	0

PHOSPHOR BRONZE.

	Per lb basis.
Strip	1 5½
Sheet	1 6½
Wire	1 5½
Rods	1 5½
Tubes	1 7½
Castings	1 3

Delivery 3 cwt. free to any town.

10% phosphor copper, £40 above price of B.S.

15% phosphor copper, £50 above price of B.S.

Phosphor tin (5%), £30 above price of English ingots.

CHARLES CLIFFORD & SON, LIMITED, BIRMINGHAM.

NICKEL SILVER, SHEET METAL, WIRE AND TUBES.

	Per lb.
Ingots for raising	1/1 to 1/7
Rolled—	
To 9 in. wide	1/8½ to 2/2½
To 12 in. wide	1/9 to 2/3
To 15 in. wide	1/10 to 2/4
To 18 in. wide	1/11 to 2/5
To 21 in. wide	2/– to 2/6
To 24 in. wide	2/1 to 2/7
Ingots for spoons and forks	1/1 to 1/7
Ingots rolled to spoon size	1/4 to 1/10
Wire round—	
3/0 to 10. G.	1/11 to 2/6

with extras according to gauge.

AMERICAN IRON & STEEL.

At Pittsburgh unless otherwise stated.	Dols.
No. 2X foundry, Phila.	20.84
No. 2 foundry Valley	21.00
No. 2 foundry, Birm.	19.00
Basic	20.96
Bessemer	21.96
Malleable	21.96
Grey forge	21.96
Ferro-manganese 80 % delivered	70.00
Bess. rails, h'y, at mill	45.00
O.-h. rails, h'y, at mill	47.00
Bess. billets	29.00
O.-h. billets	29.00
O.-h. sheet bars	30.00
Wire rods	40.00
	Cents.
Iron bars, Phila.	2.05
Steel bars	1.70
Tank plates	1.70
Beams, etc.	1.75
Skelp, grooved steel	1.80
Skelp, sheared steel	1.80
Steel hoops	2.25
Sheets, black, No. 28	2.75
Sheets, galv., No. 28	3.75
Sheets, blue an'l'd, 9&10	2.25
Wire nails	2.75
Plain wire	2.50
Barbed wire, galv.	3.40
Tinplate, 100-lb. box	$5.25

COKE.

Welsh foundry	—
„ furnace	—
Durham & North. foundry	53/-
„ furnace	35/-
Other Districts, foundry	60/-
„ furnace	30/-